Delta Levees Investment Strategy

Presentation to the Delta Science Program Peer Review Panel

Delta Stewardship Council

May 2015

DELTA STEWARDSHIP COUNCIL

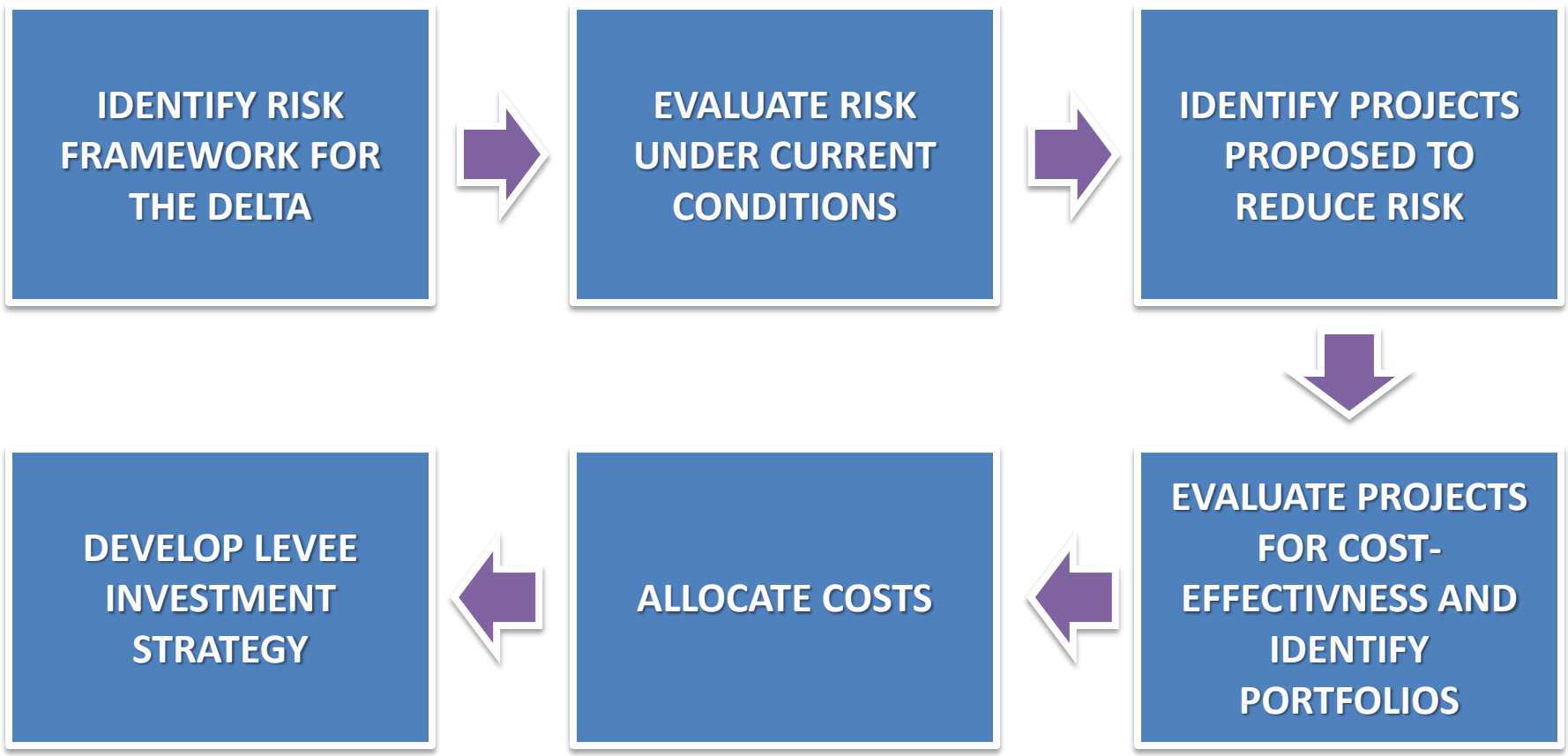
Discussion topics

- Describe a rational basis for assessing relative risks in the Delta
- Show how we can assess relative risk in ways that can be readily updated based on new or changing information
- Describe how proposed new levee improvement projects can be readily measured and compared for their
  - *Ability to reduce risk to lives and property, to water supply, to the ecosystem, and to Delta as a place*
  - *Cost-effectiveness*
- Describe cost allocation methods

Approach assesses how investments will reduce risk in the Delta and at what cost

1. Inventory assets and identify hazards
2. Evaluate risks without investment
3. Rank island/tracts by risk
4. Evaluate levee investments
5. Rank levee investments by risk reduction and cost
6. Evaluate risks with State levee investment
7. Define Delta Levee Investment Strategy

Today's presentation focuses on project methodology



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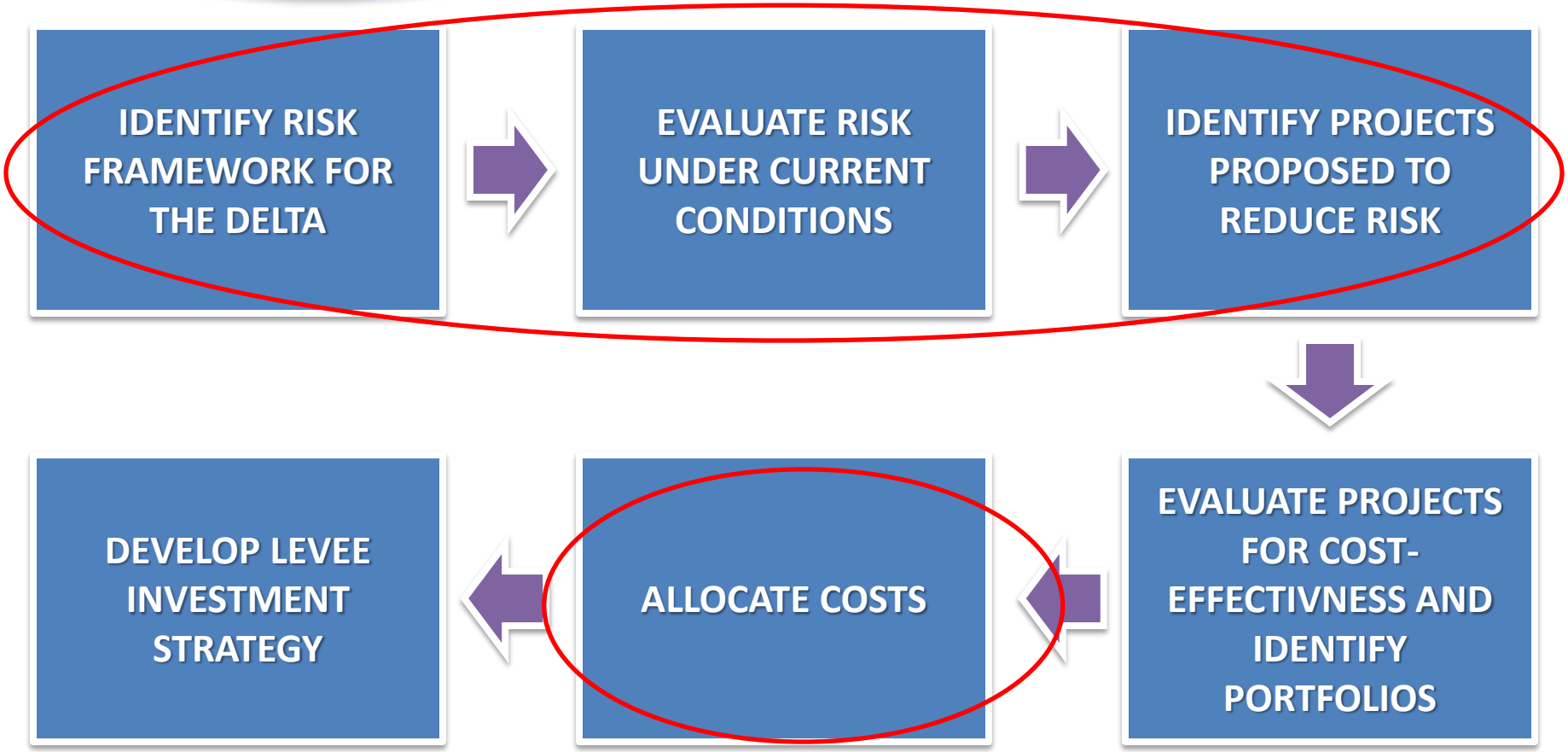

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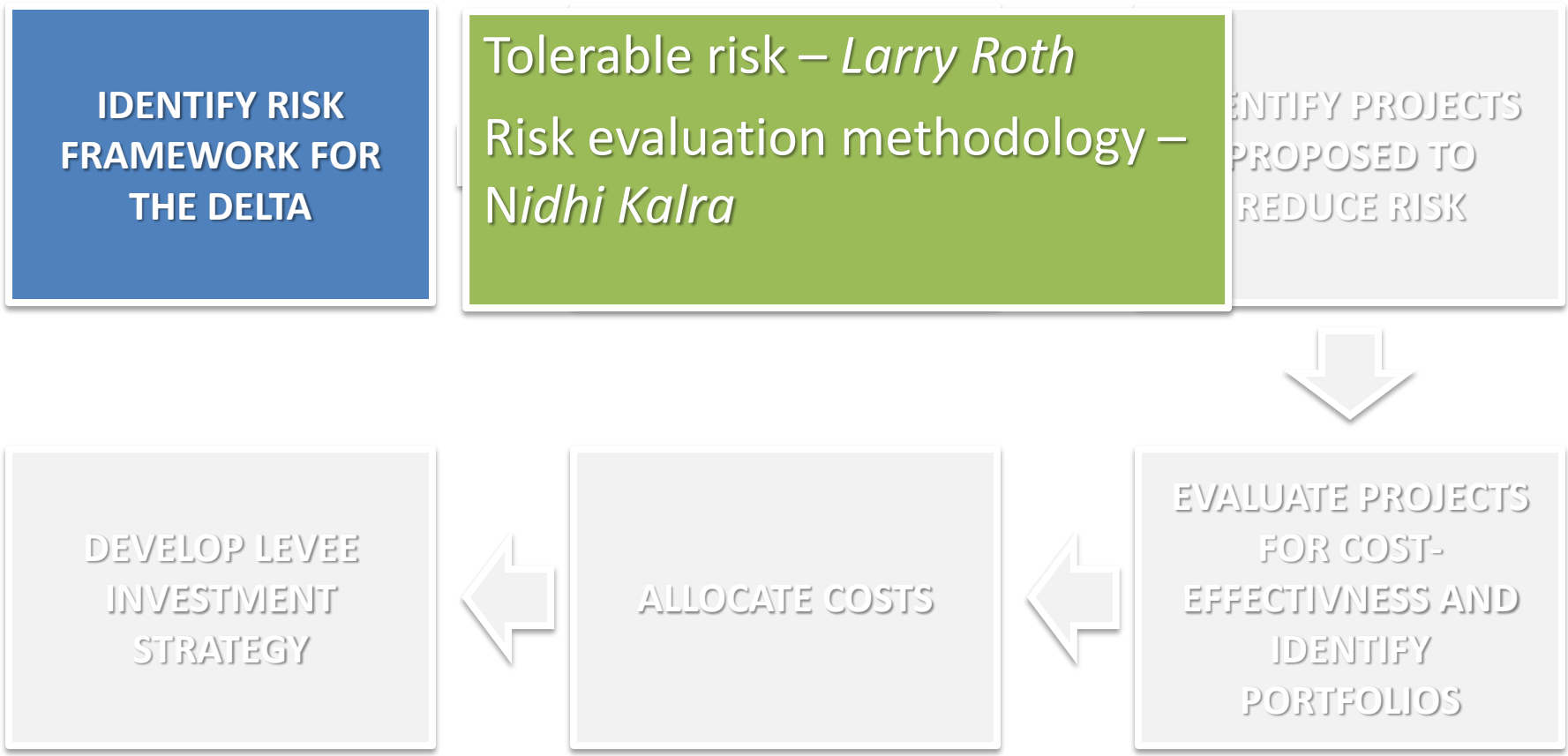

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Islands, assets, and beneficiaries

– *Jessica Ludy*

Hazards

– *Hollie Ellis*

Lives and property

– *Hollie Ellis*

EVALUATE RISK UNDER CURRENT CONDITIONS

Water supply disruption

– *Alex Trahan*

Ecosystem

– *Ramona Swenson*

Agriculture

– *Jessica Ludy*

INVESTMENT STRATEGY

ALLOCATE COSTS

EFFECTIVNESS AND IDENTIFY PORTFOLIOS

Today's presentation focuses on project methodology

IDENTIFY RISK FRAMEWORK FOR THE DELTA

EVALUATE RISK UNDER CURRENT CONDITIONS

IDENTIFY PROJECTS PROPOSED TO REDUCE RISK

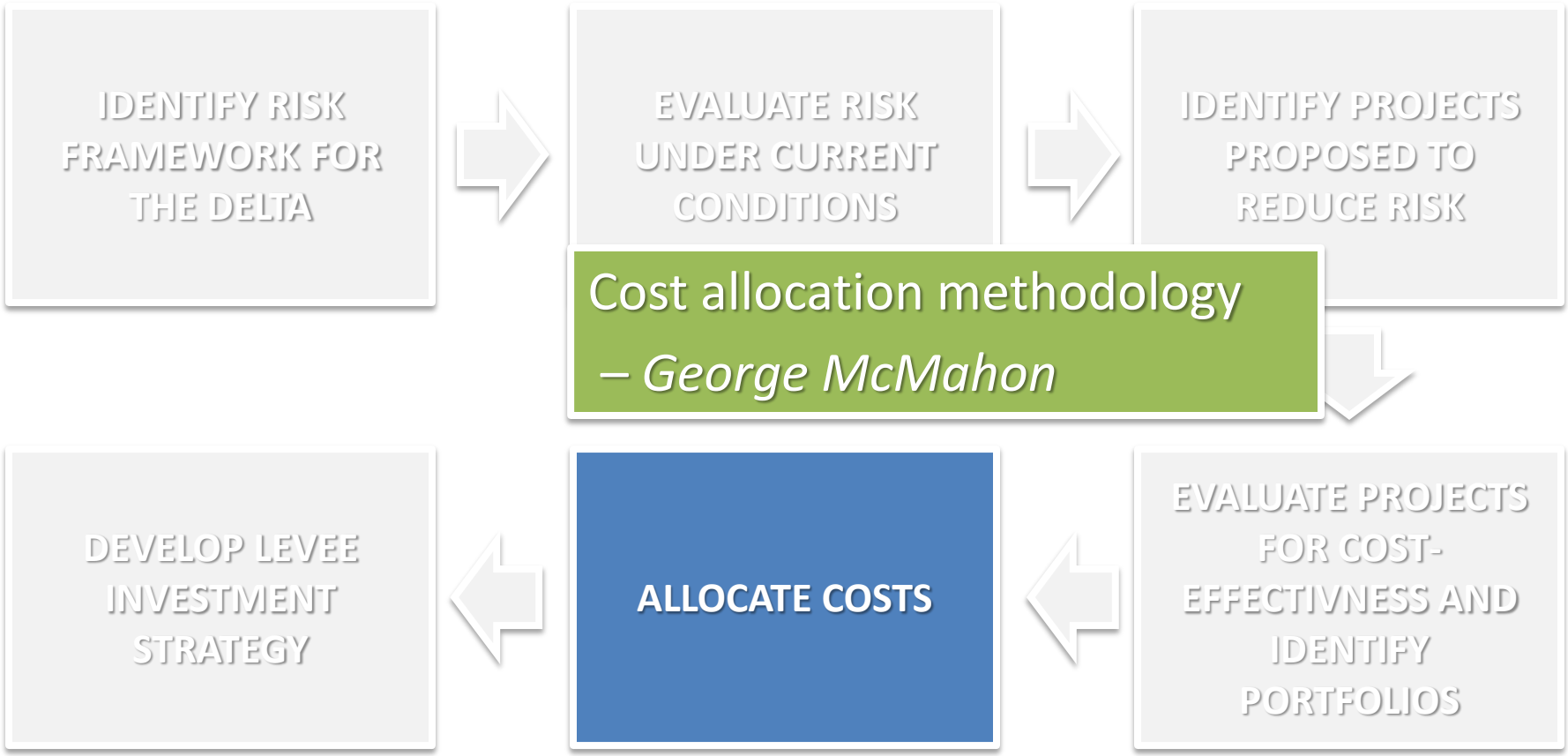
EVALUATE PROJECTS FOR COST-EFFECTIVNESS AND IDENTIFY PORTFOLIOS

DEVELOP LEVEE INVESTMENT STRATEGY

Bringing it all together

- David Groves

Today's presentation focuses on project methodology



Larry Roth

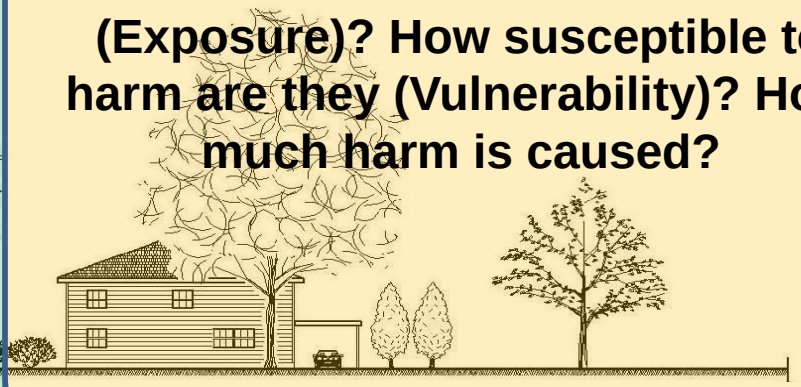
TOLERABLE RISK

What is risk?

What are the **hazards** and how likely are they to occur?

How will the infrastructure **perform** in the face of these hazards?

Who and what are in harms way (Exposure)? How susceptible to harm are they (Vulnerability)? How much harm is caused?



Risk = probability x consequences

The probability of a levee breach and subsequent flood are due to many factors

- High water levels in the Delta
- Seismic activity
- Condition of levees

Consequences from levee failure and floods create different types of risk

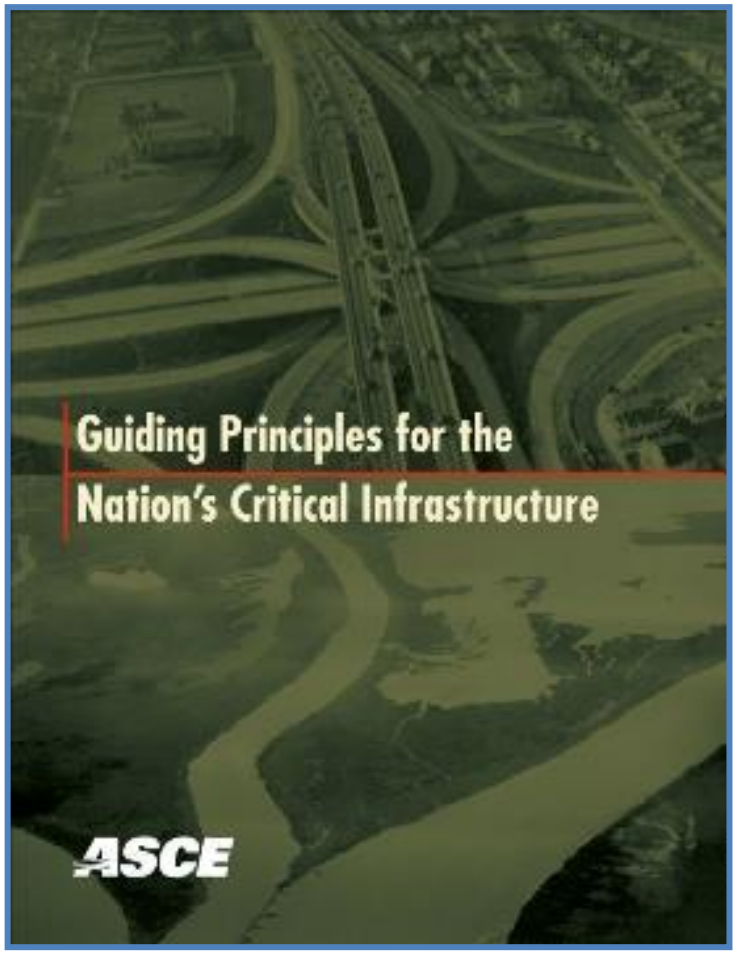
- High water levels in the Delta
- Seismic activity
- Condition of levees

Threats to…

- Lives and property
  - *Life safety*
  - *Physical assets*
  - *Agricultural land*
  - *Crops*
- Ecosystem function
- Water supply

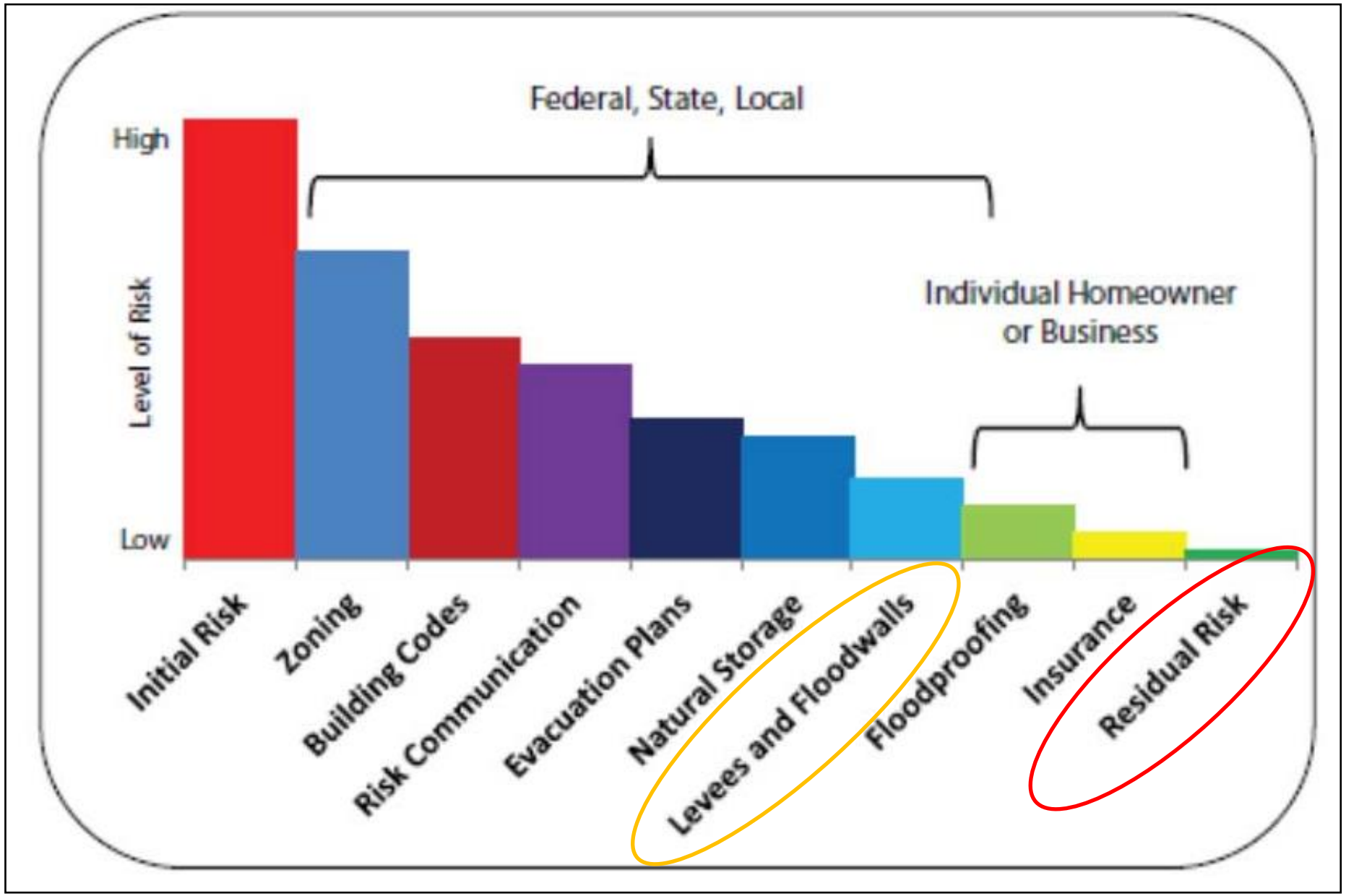
Critical Infrastructure systems must hold paramount the safety, health, and welfare of the public it serves

- Exercise sound leadership
- Use a systems approach
- Adapt to change
- Understand, manage, and communicate risk



How do you manage risk?

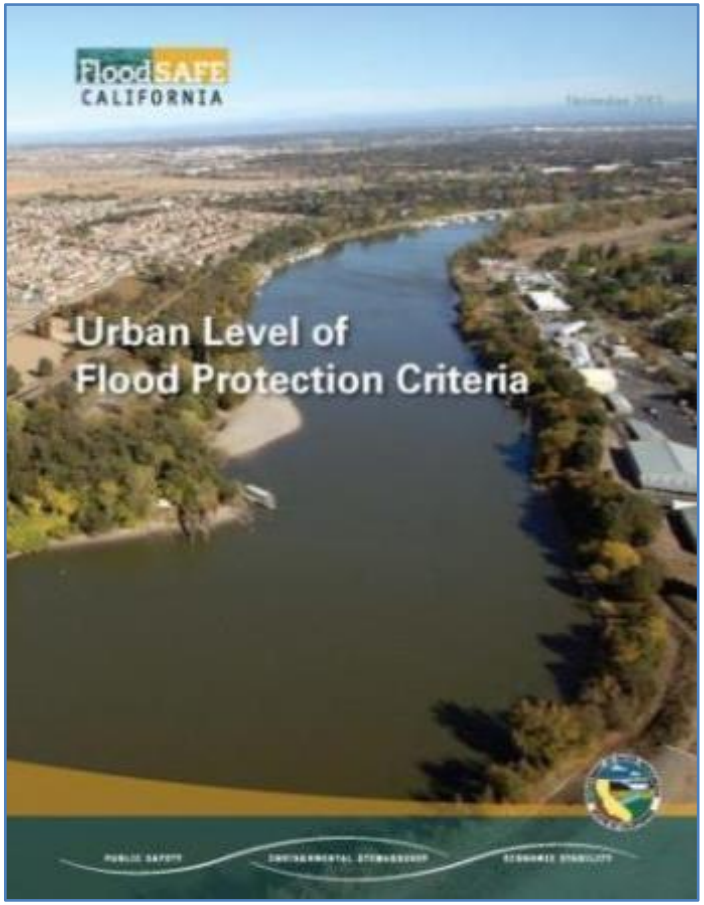
- Historically
  - *This approach seeks to **eliminate** risk*
  - *It emphasizes design standards and "levels of protection"*
  - *It focuses on **hazards** and ignores **consequences***
- This project
  - *Seeks to **reduce risk** to tolerable levels*
  - ***Manages risk** by making cost-effective investments*



American Society of Civil Engineers 2014

What "Standards" Do We Have?

- Disaster rehabilitation *guidelines*
  - *Hazard Mitigation Plan (HMP)*
  - *PL 84-99*
- Levee design standards
  - *1/100 AEP (FEMA)*
  - *1/200 AEP (CA urban areas)*
- Do not recognize residual risks from larger floods
- None are safety standards



Why not “Appropriate Levels of Protection”?

- What is “appropriate”?
- Focuses on hazard, ignores consequence
- Implies risk can be eliminated
- Basic geometry – says nothing about levee performance
- Tolerable Risk represents a shift from flood *control* to flood risk *management*

Risk cannot be completely eliminated

- **Tolerable Risk** is: the level of risk that people are willing to live with in order to secure certain benefits

Range of Risk Tolerability

A tolerable risk approach

- Enables a comprehensive look at probabilities *and consequences*
- Informs decisions about reducing risk
- Supports policy setting and decision-making
- Evaluates trade-offs
- Useful in allocating scarce resources
- Advantages
  - *Clarity*
  - *Transparency*
  - *Efficiency*
  - *Consistency*

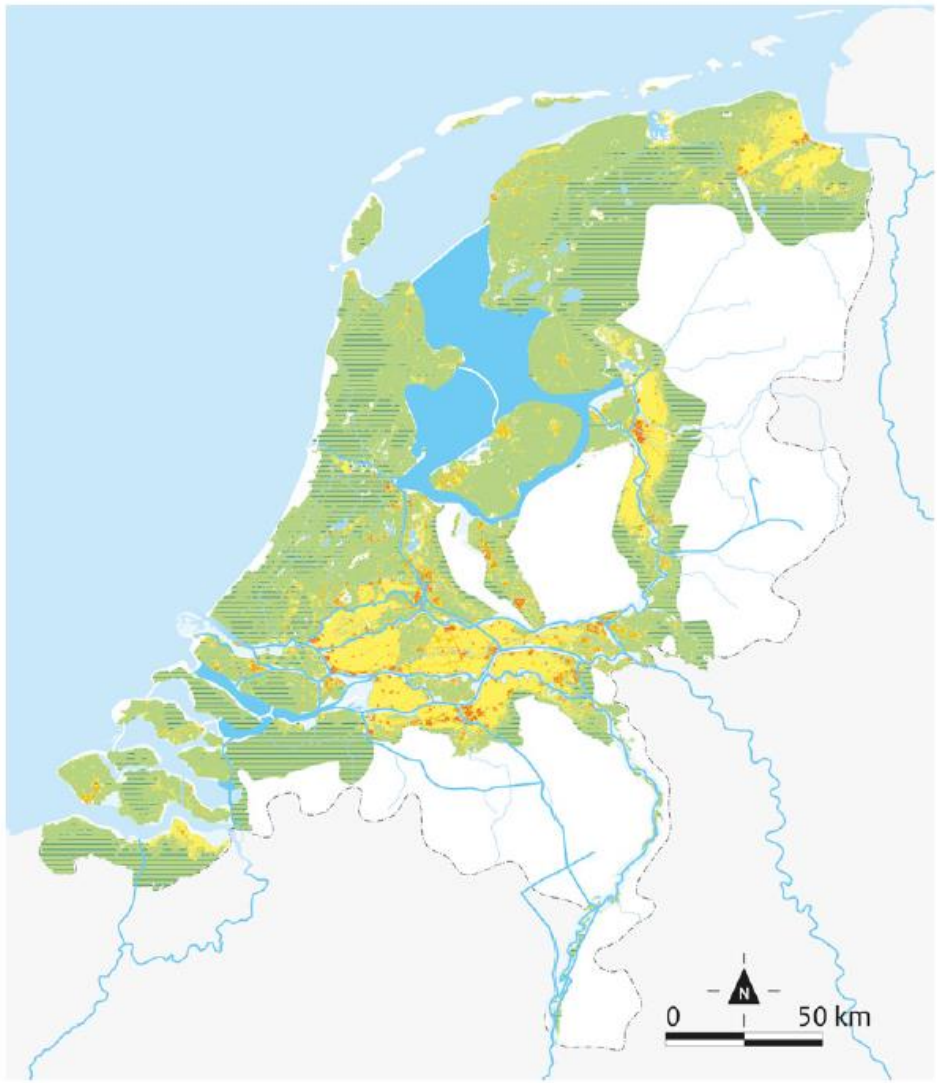
Tolerable risk principles

- Risk cannot be ignored
- Absolute safety cannot be guaranteed
- Equity
- Efficiency
- Individual risk and Societal risks
- Enables continuous review

Goal = Reduce risk to *as low as reasonably practicable* (ALARP)

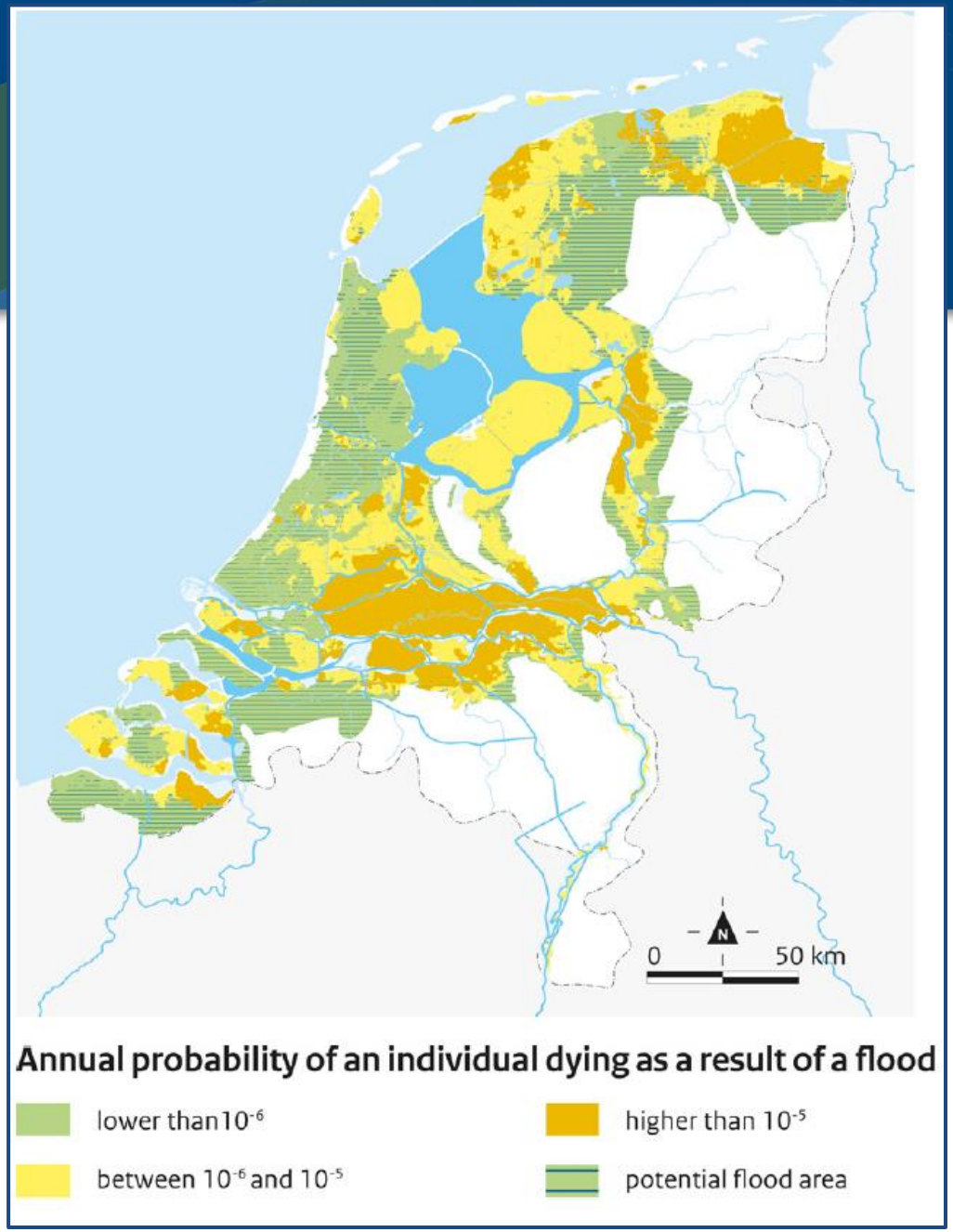
Risk Mapping

Expected Annual Damages in the Netherlands

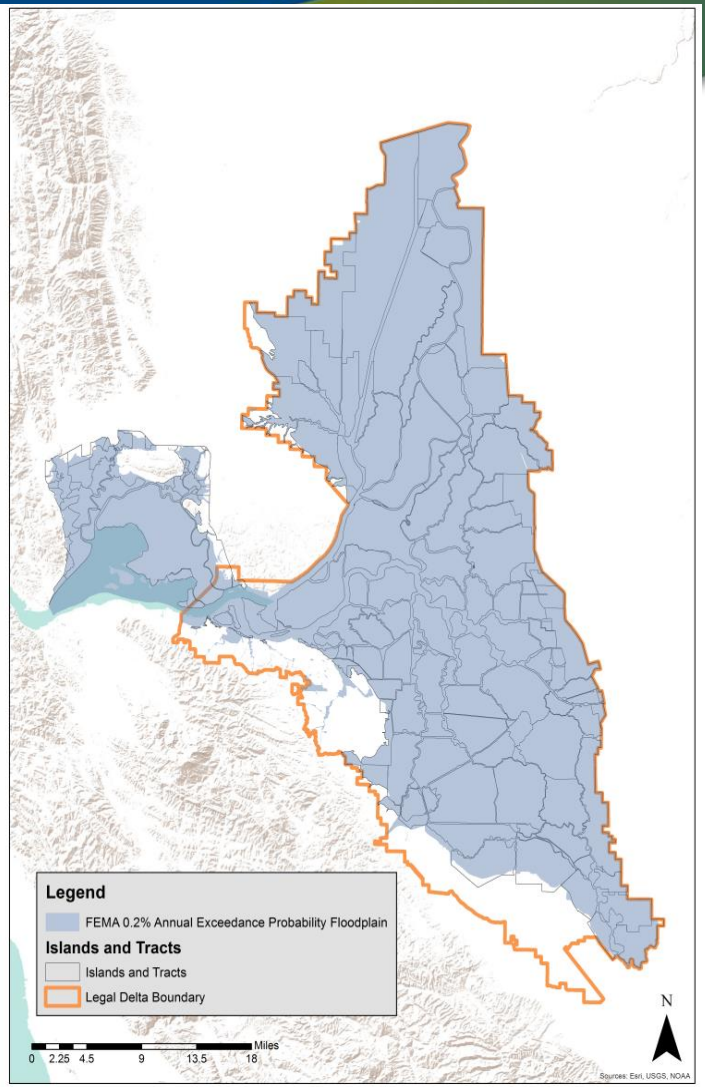


Risk Mapping

Expected Annual Life loss in the Netherlands



Delta Risk Maps



AGGREGATE RISK

AGRICULTURE RISK

ECOSYSTEM RISK

WATER SUPPLY RISK

FLOOD DAMAGE RISK (EAD)

LIFE LOSS RISK

Nidhi Kalra

PLANNING FRAMEWORK

There are several challenges to applying the approach and developing this strategy

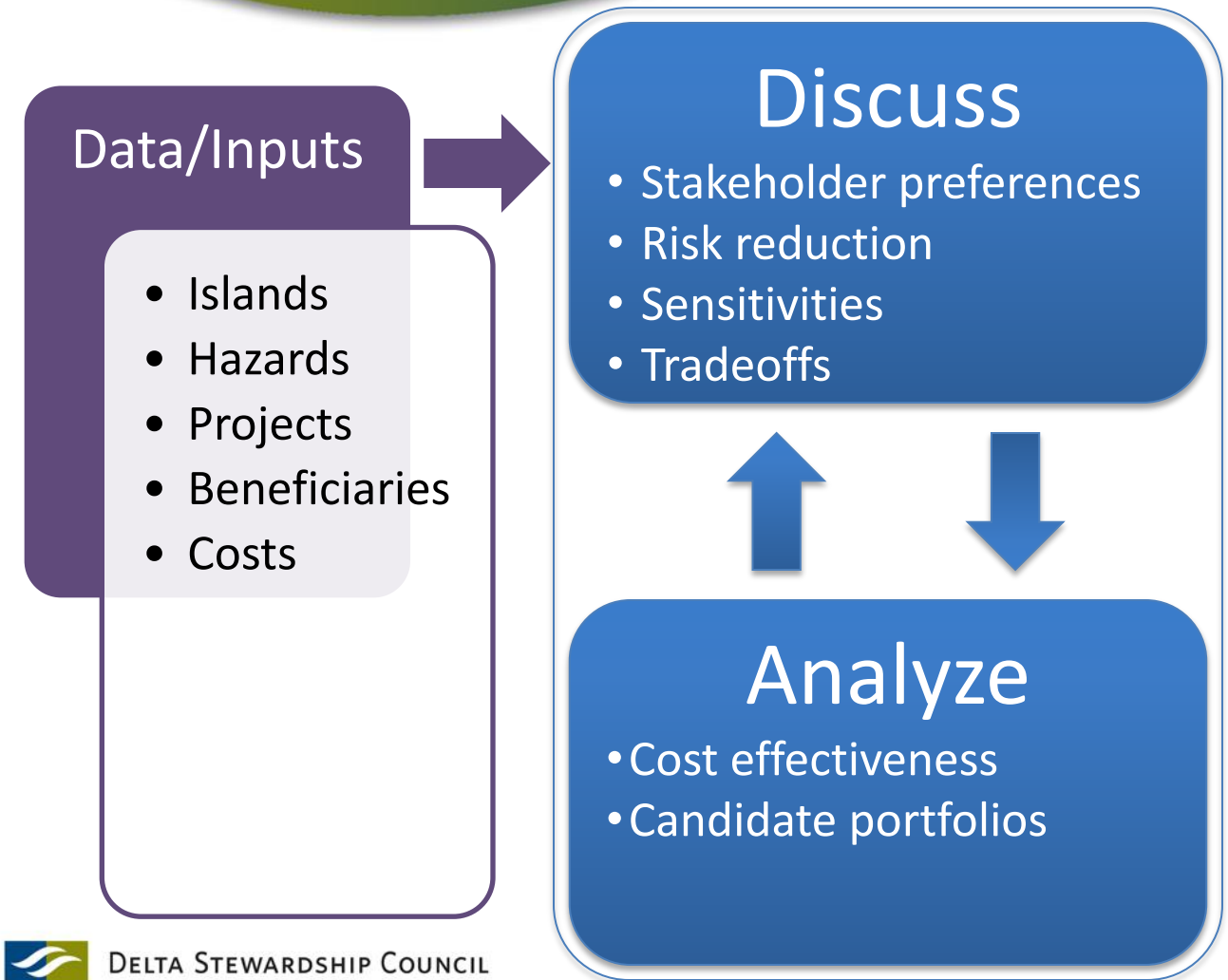
- The Delta is complex
- The future is uncertain
- Data are always evolving
- Stakeholders have different interests

We are developing a process for credible, transparent, collaborative decision making

Data/Inputs

- Islands
- Hazards
- Projects
- Beneficiaries
- Costs

We are developing a process for credible, transparent, collaborative decision making



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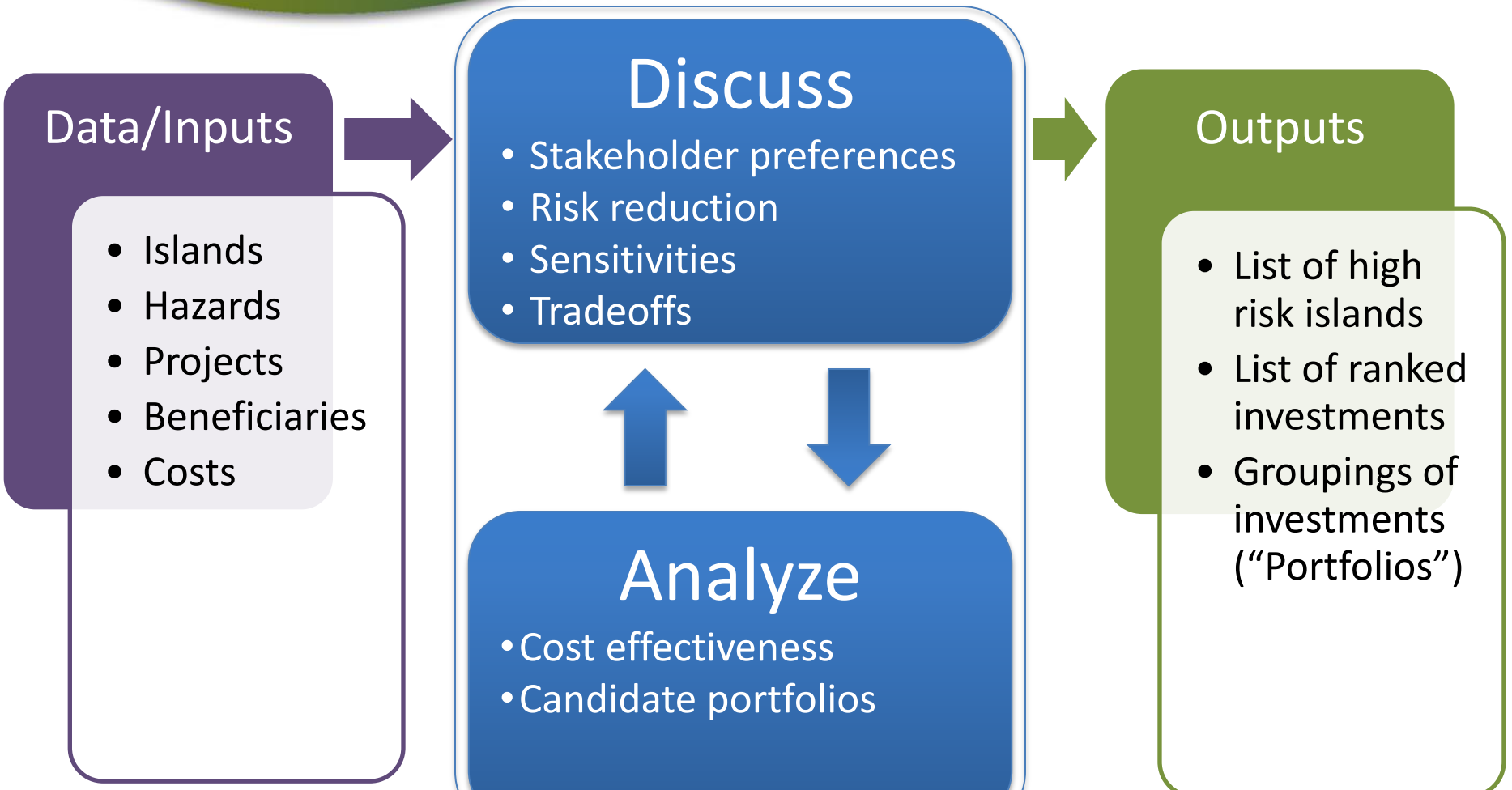


How does the Delta levee system perform in reducing risk to lives, property, and State interests?

Lives and Property

Ecosystem Function

Water Supply Reliability

Delta as Place

We use performance metrics to evaluate risks with and without investment

Expected Annual Fatalities

How many lives would we expect to lose on average annually to floods?

Expected Annual Damage

What damage to structural, agricultural, and other assets would we expect to incur on average annually due to floods?

We use performance metrics to evaluate risks with and without investment

Expected Annual Water Supply Disruption Score

What is the risk of water supply disruption due to levee failure in the Delta?

We use performance metrics to evaluate risks with and without investment

Expected Annual Change in Habitat

How much habitat area would change on average annually due to floods?

We use several performance metrics to evaluate risks with and without investment

Expected Annual Agricultural Land Loss

What amount of agricultural land would we lose on average annually due to floods?

We also evaluate the efficiency of the investments

Costs of Levee Investments

How much would individual investments cost?

Projected effect on habitat

How much habitat is gained or lost from different investments?

Projected effect on agricultural land

How much agricultural land is lost from different investments?

We will assess risk at three points in time

Risk may change over time due to:

- Rising sea levels
- Some population increase in Secondary Zone
- Construction of water conveyance
- Implementation of ecosystem restoration projects
- Levee conditions (improvements or degradation)

Jessica Ludy

INVENTORY ASSETS & IDENTIFY BENEFICIARIES

Data Goals

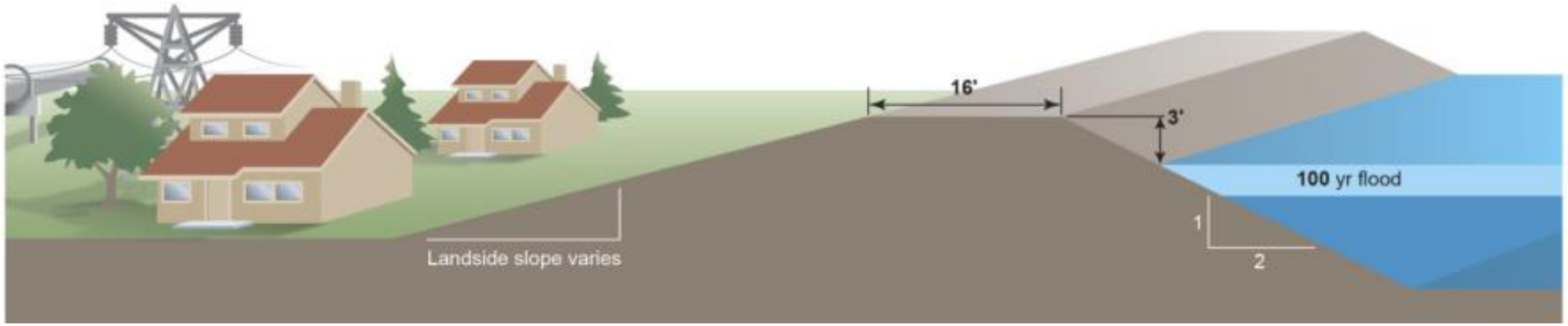
- Use existing data to support DLIS analysis
- Identify data gaps, uncertainties, and limitations
  - *Share data inventories*
  - *Validate with stakeholders*
  - *Stakeholder review will help identify outliers*

Data

- Data varies in age and level of detail
- Supports assessing relative risks
  - *Enables ready incorporation of new or updated data*
  - *Enables a wide range of sensitivity analyses*
    - *How might parcel data or evacuation routes data affect State levee investments?*

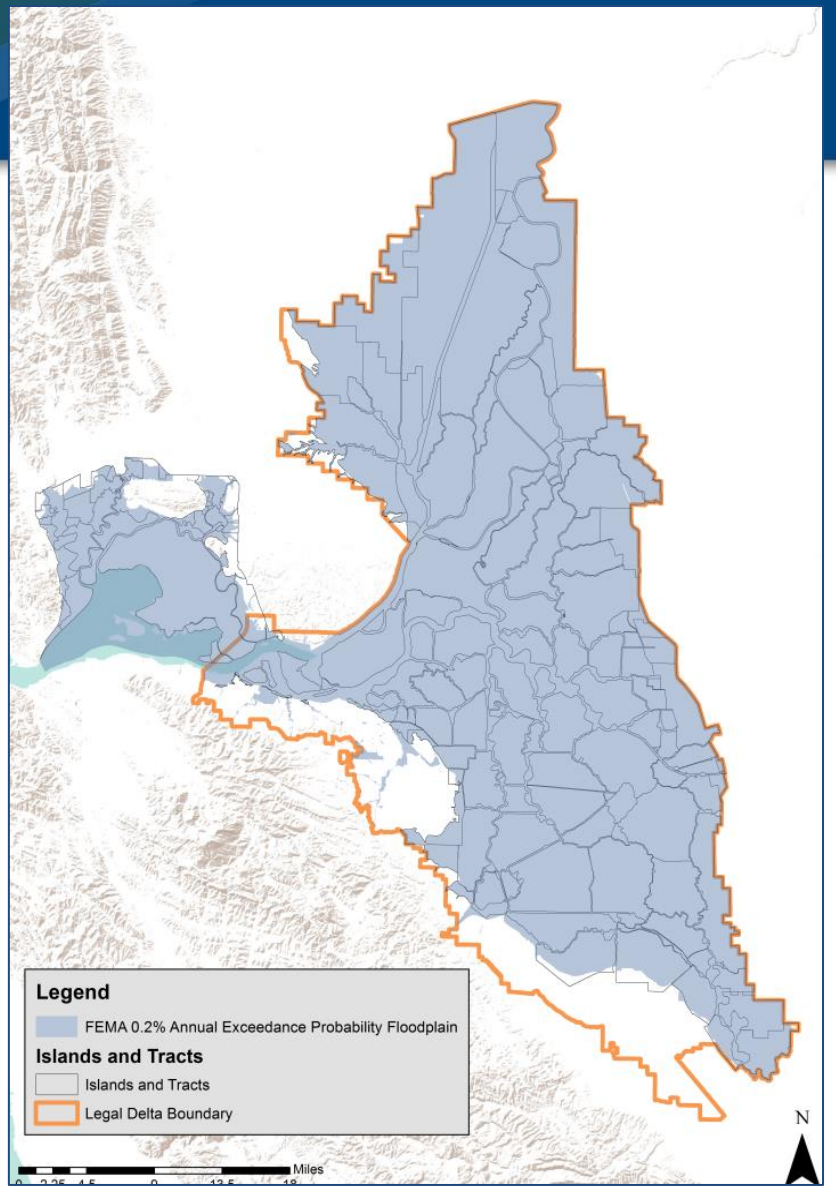
Data

- Working with partner agencies to acquire improved datasets
- Working with Council to develop a process for incorporating new data when available



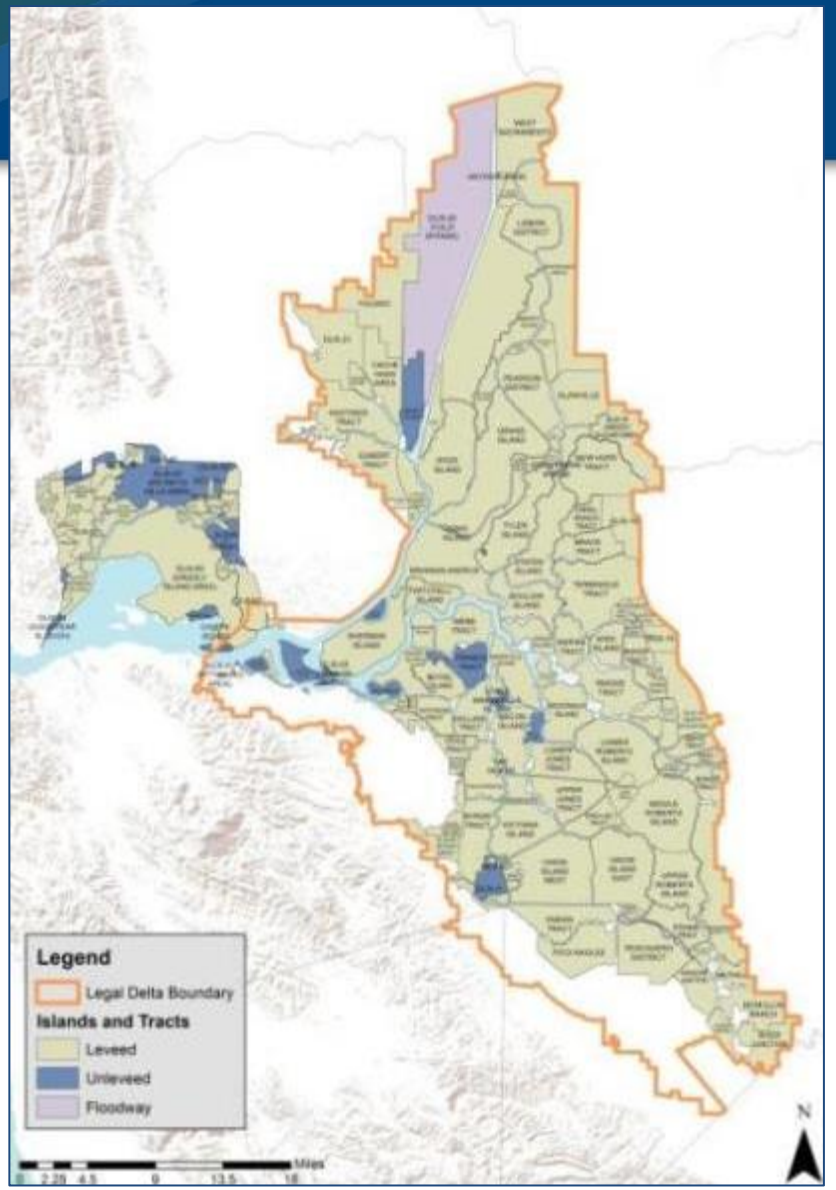
Islands & Tracts

- Goal: Develop a single list of islands and tracts
- Geographic Scope
  - *Legal Delta, Suisun Marsh*
  - *FEMA delineated 0.2% AEP floodplain boundary*



Islands & Tracts

- Consolidated and reconciled diverse lists
  - *No single, agreed-upon list of Delta islands existed*
  - *Worked with RDs and partner agencies to refine*
- Delta and Suisun Marsh
  - *170 Islands and tracts*
  - *(+ 6 flooded islands)*

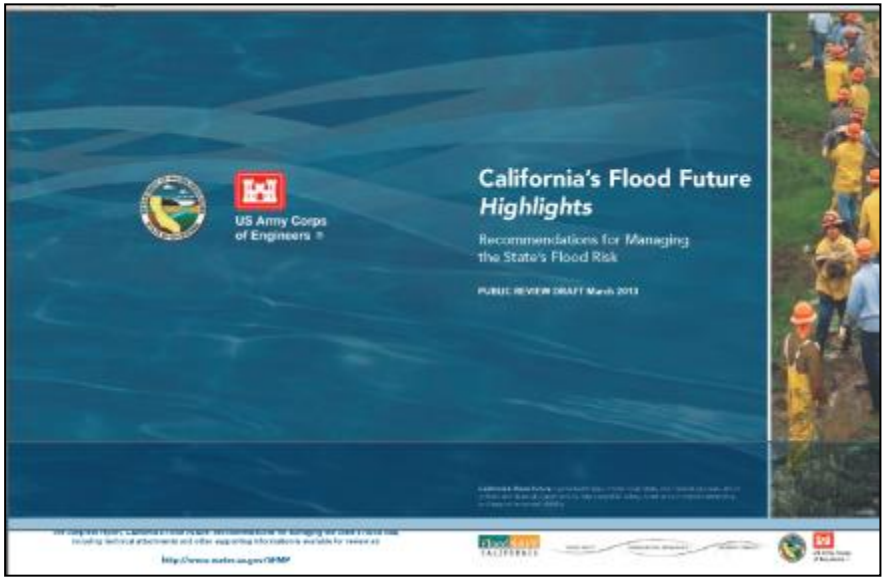


Assets

- Goal: use existing data to compile a list of assets affected by levees
- Identify data gaps, limitations, and uncertainties
  - *Assets are the basis for assessing the consequences of flooding and the benefits of reducing risk*

Asset types and inventory align with other State-level exposure analyses

- Lives and Property
  - *Parcel data*
  - *Population count*
  - *Energy, Utilities, Infrastructure*
  - *Critical facilities*
  - *Transportation, Navigation*
  - *Wastewater treatment plants*
  - *Public facilities, schools, etc.*



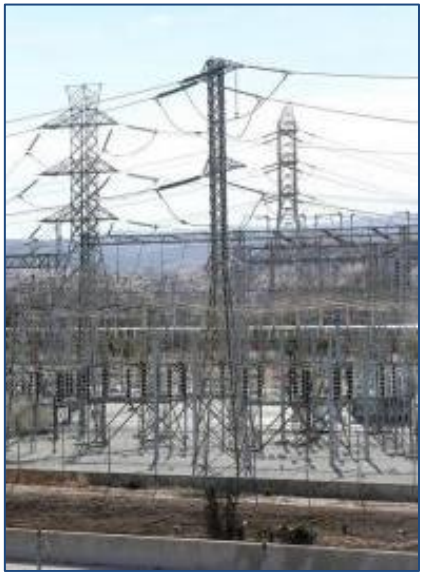
Asset types and inventory align with other State-level exposure analyses

- Delta as Place
  - *Agriculture*
  - *Public lands*
  - *Cultural Resources*
  - *Recreation*
- Ecosystem
  - *Habitat area*
- Water Supply
  - *Conveyance*
  - *Intakes*

Asset Inventory

BISHOP TRACT	
County:	SAN JOAQUIN
Delta Zone:	Secondary Delta
Population (2010):	4543
Project Levees:	Yes
Non-project Levees:	Yes
RD Number:	2042

ASSET CATEGORY	LANDSIDE ASSETS	Quantity
	Flood Risk Assets	
Infrastructure: Energy & Telcom	Cell towers	0
Infrastructure: Energy & Telcom	Communications facilities	0
Infrastructure: Energy & Telcom	Gas fields (sq miles)	0
Infrastructure: Energy & Telcom	Gas storage	0
Infrastructure: Energy & Telcom	Gas wells	0



The Delta is a system

And a system of systems

Ecosystem

Critical infrastructure

Water supply & quality

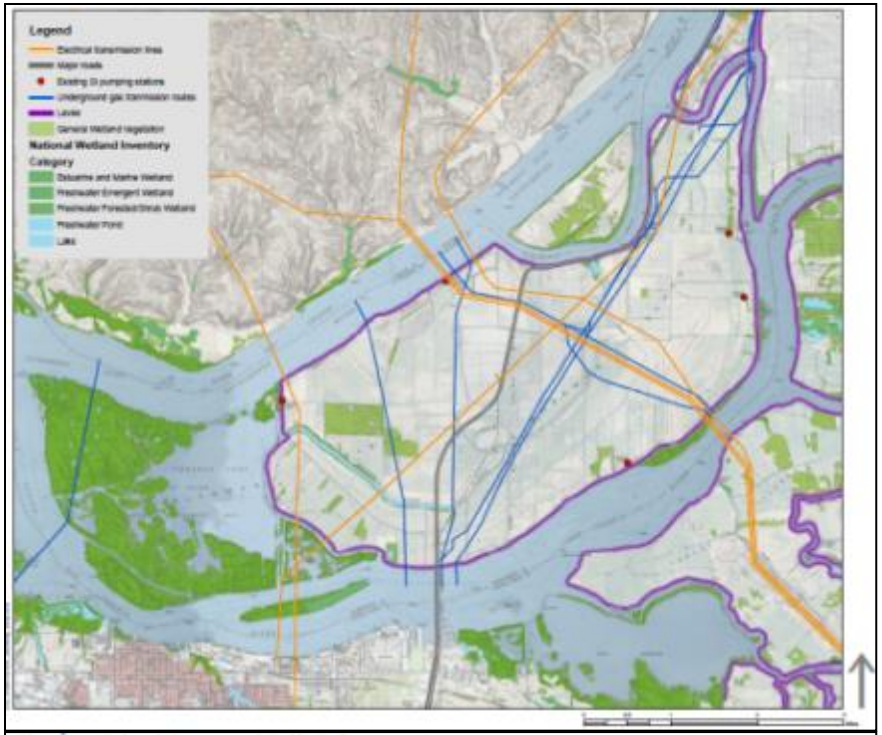
Energy

Evacuation routes

Transportation

The Delta is a system

- Challenge = capturing complex interrelationships
  - *Island as unit of analysis*
  - *Relationships with neighboring islands*
- We are looking at systems
  - *GIS enables a systems-driven approach and analyzing impacts*

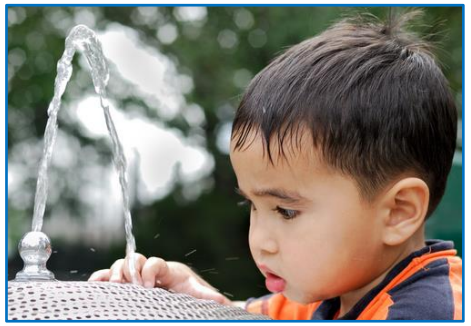


Sherman Island Green and Built-Infrastrucutre

UC Berkeley NSF RESIN Sherman Island Pilot Project. April 12, 2010
Note: built-infrastructure accurate only for Sherman Island.
Sources: Electrical and gas: RESIN; levees, pumping stations, general vegetation: URS/DRMS; roads: ESRI; National Wetlands Inventory: NWI

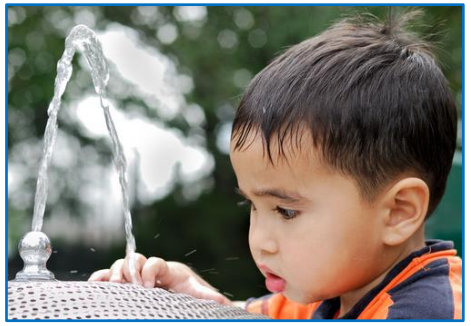
Benefits and Beneficiaries

- Goal: Identify all entities that benefit from the Delta's levees.
  - *The benefit categories inform the local-share of cost allocation*



Benefits and Beneficiaries

- Based on idea that all who benefit should contribute to maintenance and improvement
  - *Asset data and stakeholder input*
- Delta Levee Assessment District
  - *Delta Protection Commission*



Hollie Ellis

HAZARDS & VULNERABILITIES

Delta and Suisun Marsh Levee Hazards

Hazard Type	Hazard Source
Natural	Hydrologic / Hydraulic
	Wind
	Climatic Change
	Geologic /Geotechnical
	Ecologic
Human Action	Permanent or Periodic
	Temporary

Delta and Suisun Marsh Levee Hazards
Natural (1 of 2)

Hazard Source	Example
Hydrologic / Hydraulic	High volume inflow
	High flow velocity
	High head differential
	River morphology changes
	Rapid drawdown
Climatic Change	Higher water level (sea level rise)
	Greater head differential
Wind	Wave run-up
	Storm surge

Delta and Suisun Marsh Levee Hazards Natural (2 of 2)

Hazard Source	Example
Geologic / Geotechnical	Soft or organic soils below levee embankment
	Soft or organic soils on landside
	Earthquake induced liquefaction
Ecologic	Animal burrows
	Vegetation type or location

Delta and Suisun Marsh Levee Hazards Human Action

Hazard Source	Example
Permanent or Periodic	Encroachments Channel dredging Deferred maintenance Upstream water management
Temporary	Wakes Impact (ship, debris) Fires, footpaths, camping

Delta and Suisun Marsh Significant Levee Hazards

Timing	Hazard
Current and Future	Hydrologic Seismic Wind / Wave
Future	Sea level rise Deferred maintenance

Hollie Ellis

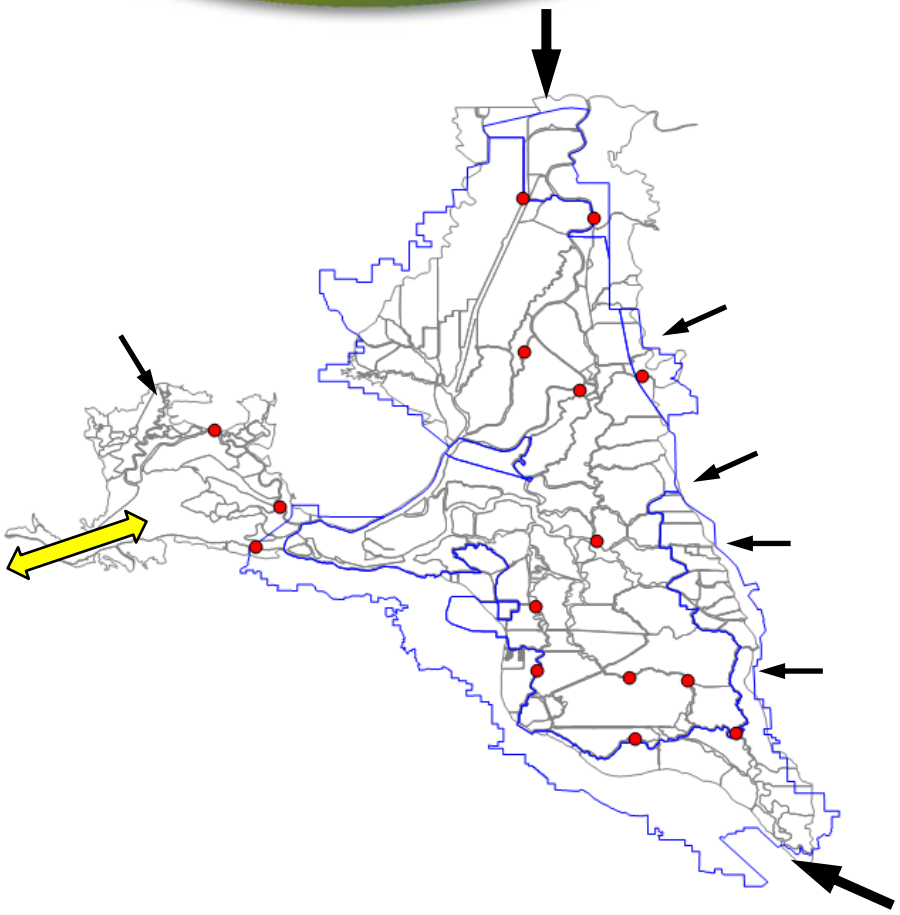
EVALUATE RISKS

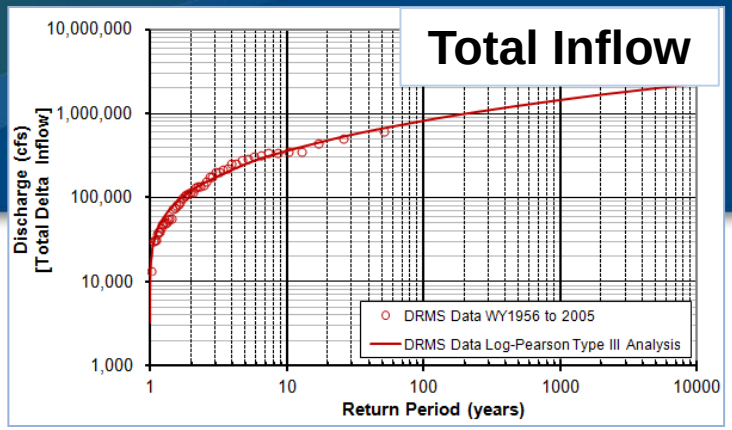
Evaluate Risks

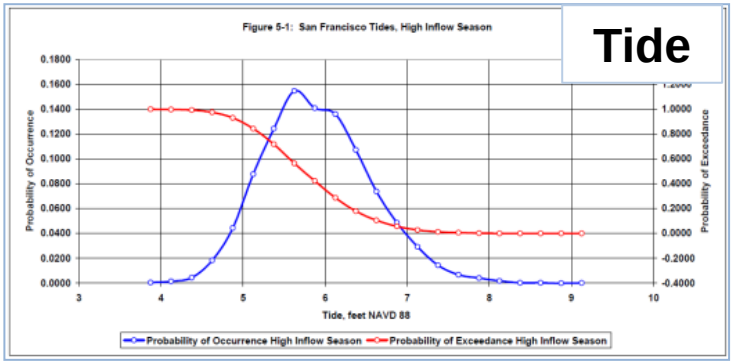
risk = probability x consequence

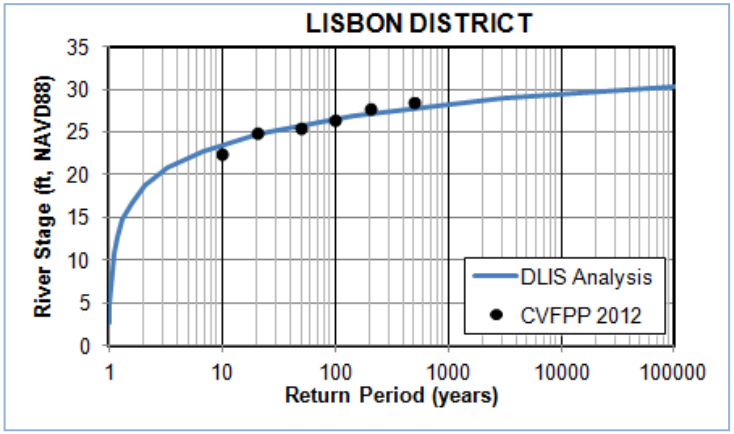
hazards and fragility ***assets and damage potential***

Stage-Recurrence



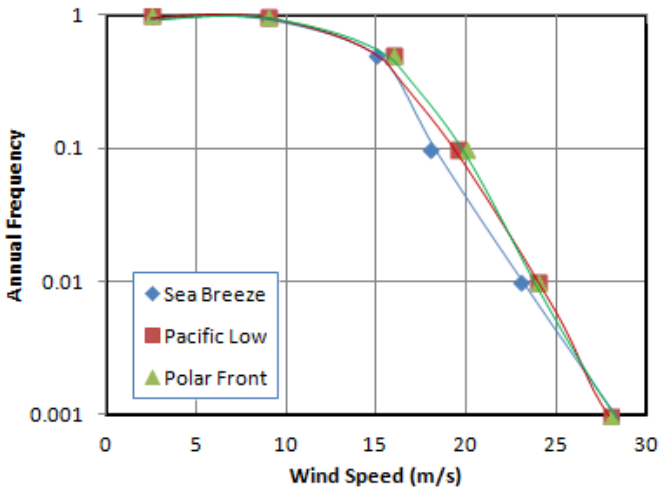






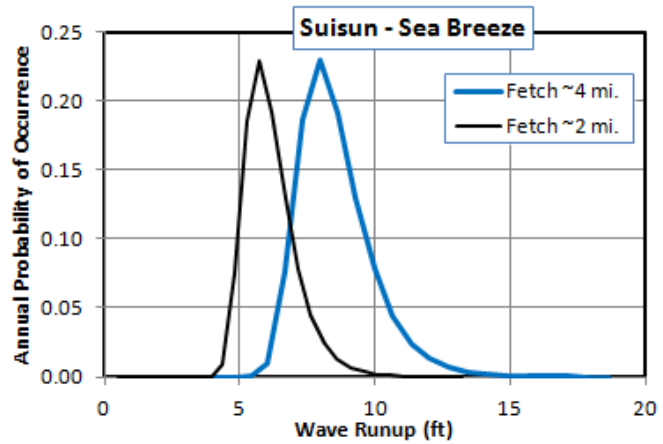
Wind / Wave Effects

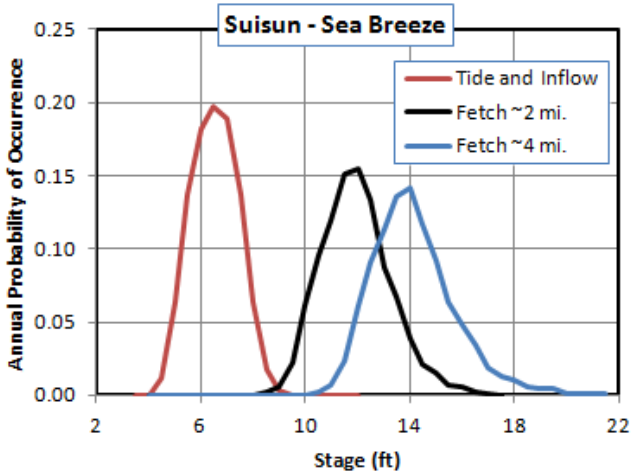
Wind Speed
Direction
Duration
Fetch



Wave Runup (m)
Levee Slope = 1.5:1 (horizontal:vertical)

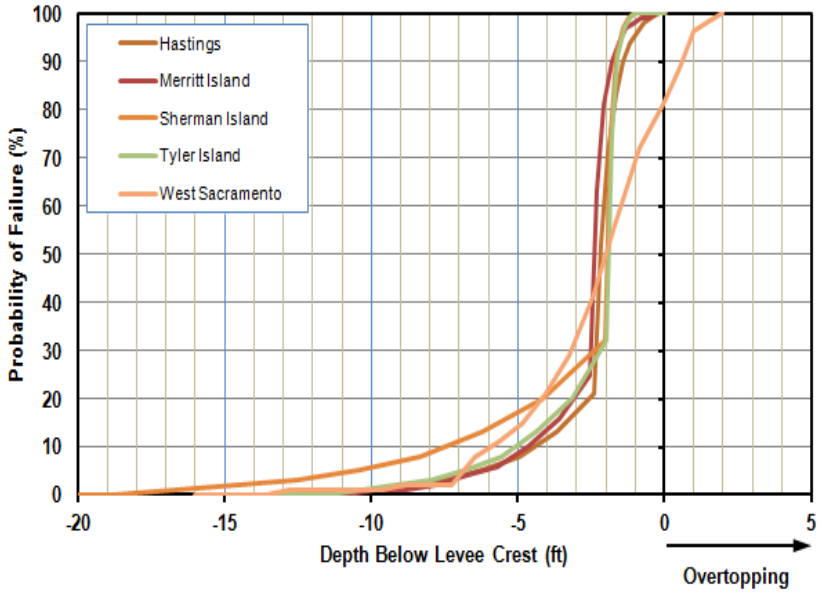
Wind Speed (m/s) \ Fetch (m)	1000	2000	3000	4000	5000	6000	7000	8000	9000
2.5	0.11	0.16	0.20	0.22	0.24	0.27	0.29	0.31	0.32
5	0.27	0.38	0.46	0.52	0.57	0.63	0.68	0.71	0.76
7.5	0.43	0.62	0.76	0.85	0.96	1.05	1.11	1.19	1.27
10	0.61	0.87	1.07	1.24	1.35	1.48	1.60	1.67	1.78
12.5	0.79	1.14	1.40	1.63	1.77	1.94	2.10	2.24	2.33
15	1.02	1.41	1.74	2.02	2.27	2.42	2.61	2.79	2.97
17.5	1.23	1.71	2.09	2.44	2.73	2.90	3.14	3.36	3.57
20	1.44	2.00	2.46	2.86	3.21	3.52	3.69	3.94	4.19
22.5	1.65	2.30	2.84	3.29	3.69	4.05	4.24	4.55	4.83
25	1.88	2.61	3.21	3.74	4.19	4.59	4.97	5.16	5.48
27.5	2.10	2.93	3.60	4.19	4.70	5.16	5.57	5.78	6.14
30	2.34	3.25	4.00	4.65	5.21	5.71	6.19	6.42	6.81
32.5	2.57	3.57	4.40	5.12	5.73	6.29	6.81	7.29	7.50
35	2.81	3.90	4.81	5.58	6.26	6.87	7.44	7.97	8.19





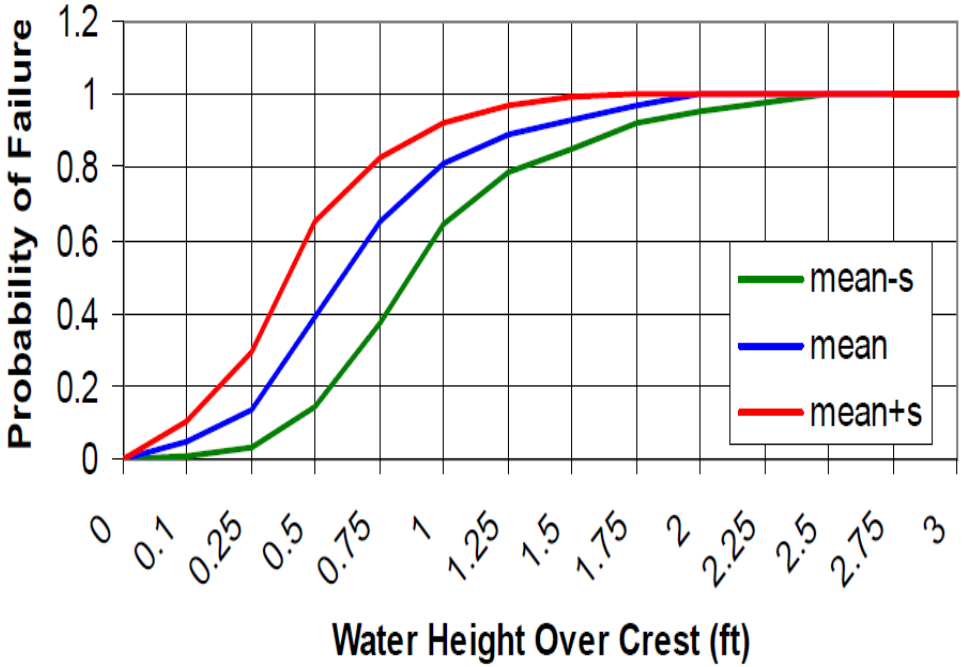
Levee Fragility - Flood

Stage-Probability of Failure

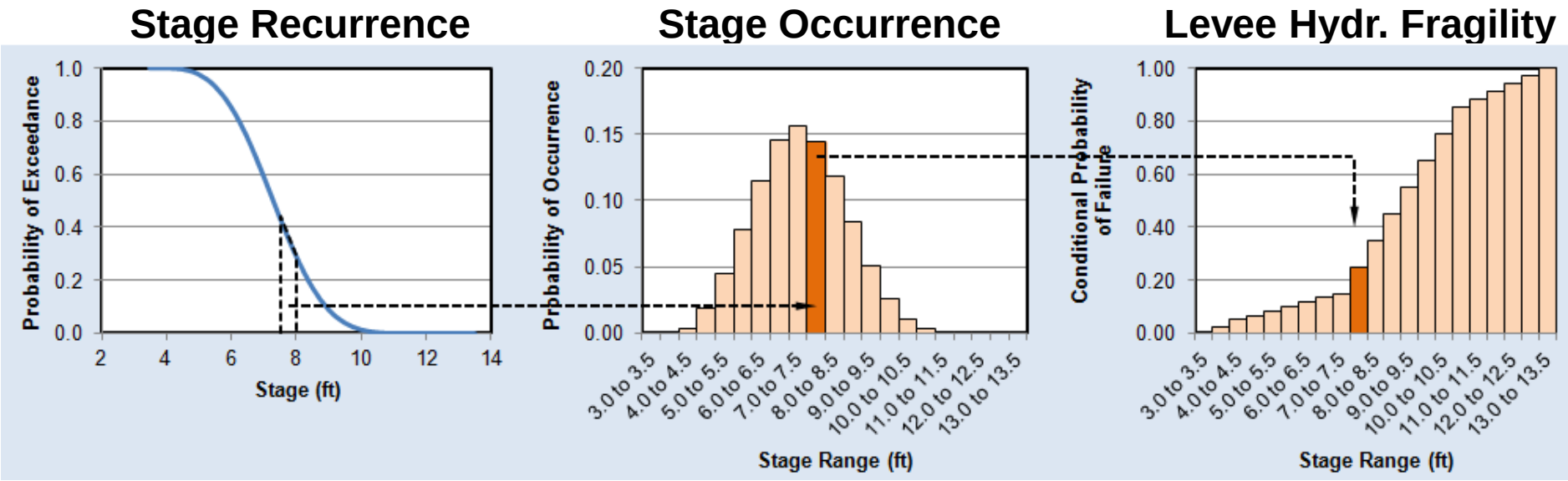


Source: CVFPP

Overtopping Fragility



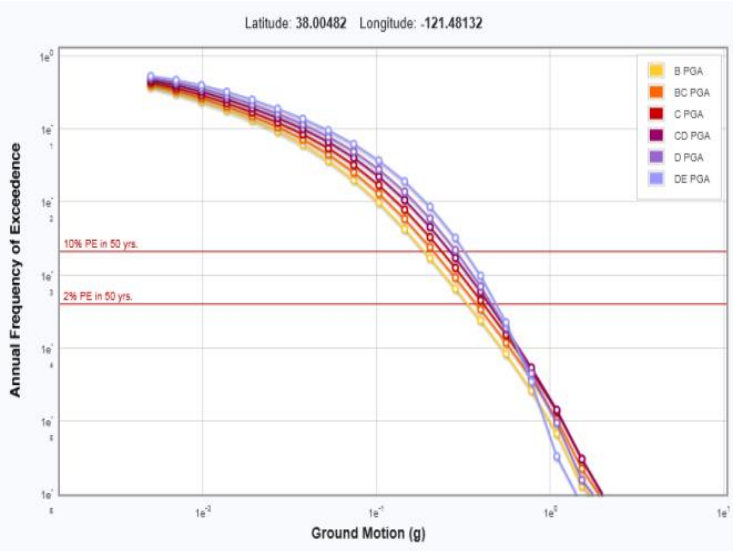
Probability of Levee Breach Due to Flood Conceptual Risk Model



Probability of levee breach stage (j)	= (prob.of occurrence of stage j) **X** (conditional prob. of failure at stage j)
Probability of hydraulic breach	$=\Sigma_j$ (prob. of occurrence of stage j) **X** (conditional prob. failure at stage j)

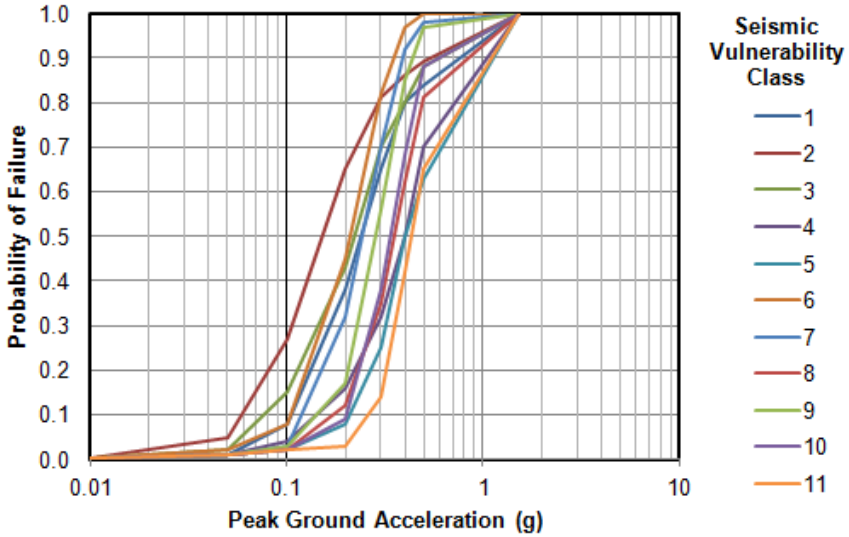
pgA Recurrence and Levee Fragility Earthquake

pga Exceedance Probability



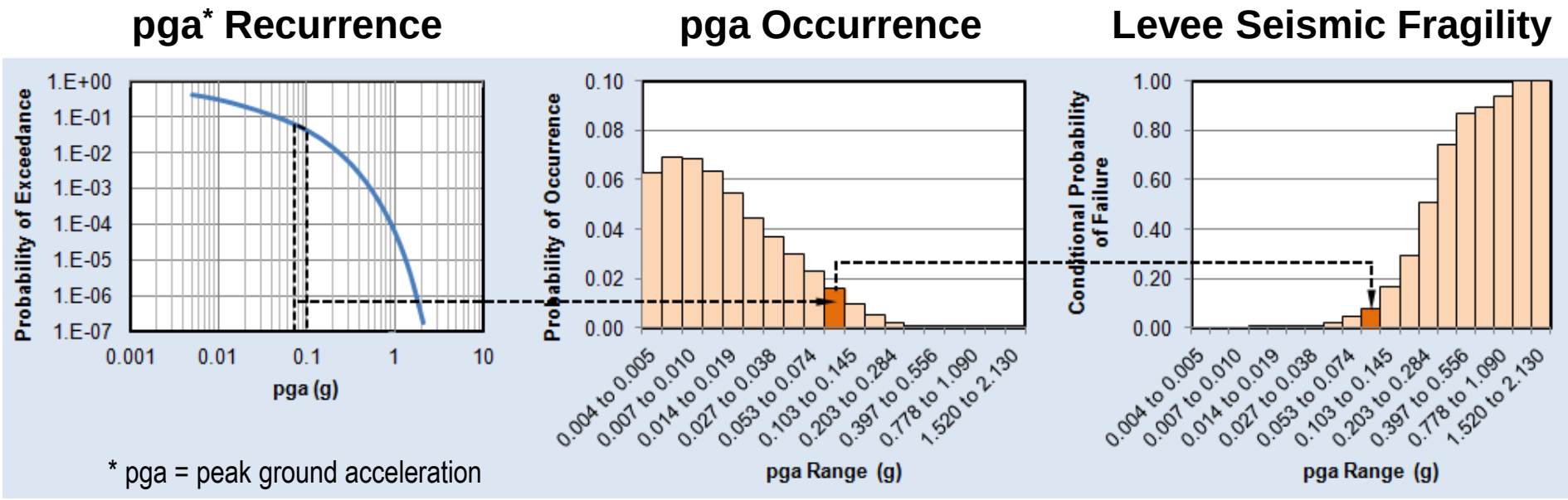
Source: USGS

Seismic Fragility



Source: DRMS

Probability of Levee Breach Due to Earthquake-Conceptual Risk Model



Probability of breach pga (j) = (prob. of occurrence of pga j) **X** (conditional prob. of failure at pga j)

Probability seismic breach = Σ_j (prob. of occurrence of pga j) **X** (conditional prob. of failure at pga j)

Delta Levees Investment Strategy

METRICS





Expected Annual Fatalities (EAF) Population

- Resident Population: 262,000
- Working population: 18,600 (equivalent)
- Recreation population: 33,200 (equivalent)
- Travelling population: 29,700

→ *Total population to be distributed over each island and tract*

Expected Annual Fatalities (EAF) Conceptual Risk Model

EAF = $\sum_j$ **Probability of levee breach(j)** x **Proportion of population exposed to flood water** x **Mortality function(j)**

Summed over all stages

Influence factors
- Population (reduced by)
- Warning time
- Evacuation response (willing/able)

Fatalities vs. depth of inundation

$$EAF_{total} = EAF_{hydrologic/hydraulic} + EAF_{seismic}$$

Expected Annual Damages (EAD) Conceptual Risk Model

$$EAD = \sum_j \text{Probability of levee breach(j)} \times \left\{ \text{Asset value} \times \text{Proportion of asset value damaged by flood water (j)} + \text{Cost of rehabilitation at flood water (j)} \right\}$$

Summed over all stages

Island asset inventory

Stage-damage curves

Fixed cost + dewatering

$$EAD_{total} = EAD_{hydrologic/hydraulic} + EAD_{seismic}$$

Expected Annual Damages (EAD) cont'd
(Rehabilitation Cost Component)

- Mobilize resources for recovery effort.
- Repair levee breach.
- Rehabilitate the island.

Cost to rehabilitate an island or tract = Cost_{fixed} + (v_i x Cost_{af})

For Island i

Volume of water to be pumped

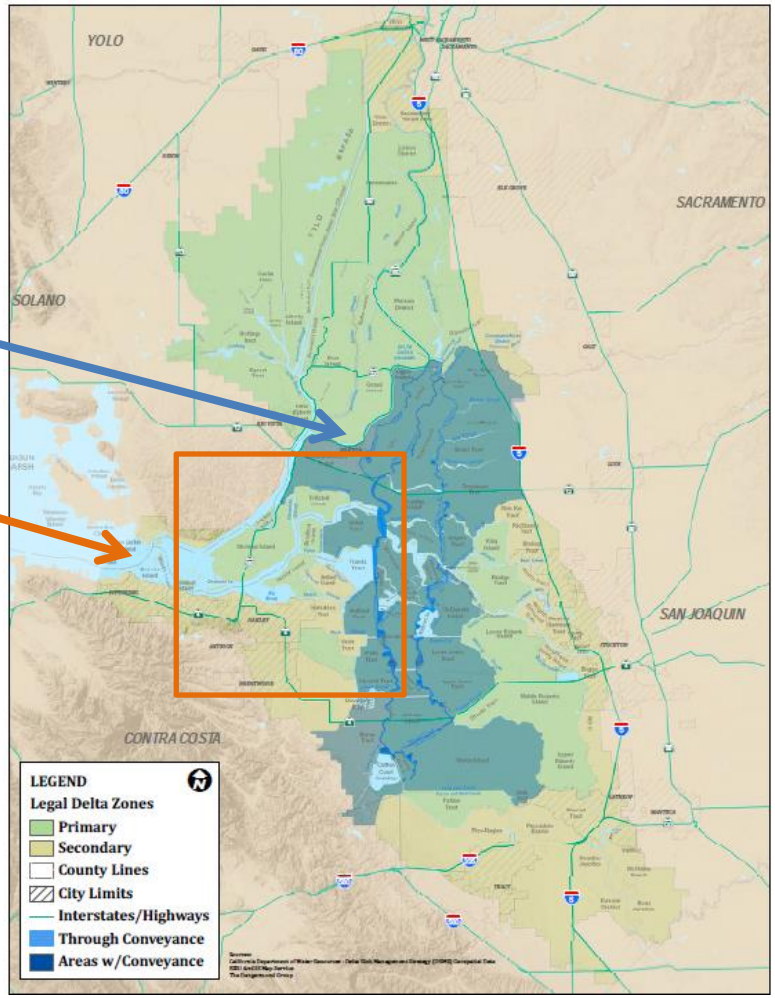
Dewatering cost per acre-foot

Rehabilitation Cost_{delta} = Σ_i Rehabilitation Cost_i


Expected Annual Water Supply Disruption Score (EAW)

Through Conveyance

Western Islands



Economic Sustainability Plan

Conceptual Model – Expected Annual Water Supply Disruption Score

EAW_i
likelihood of water supply disruption/year

=

Probability of levee breach(*i*)

From Probabilities of Levee Failure

x

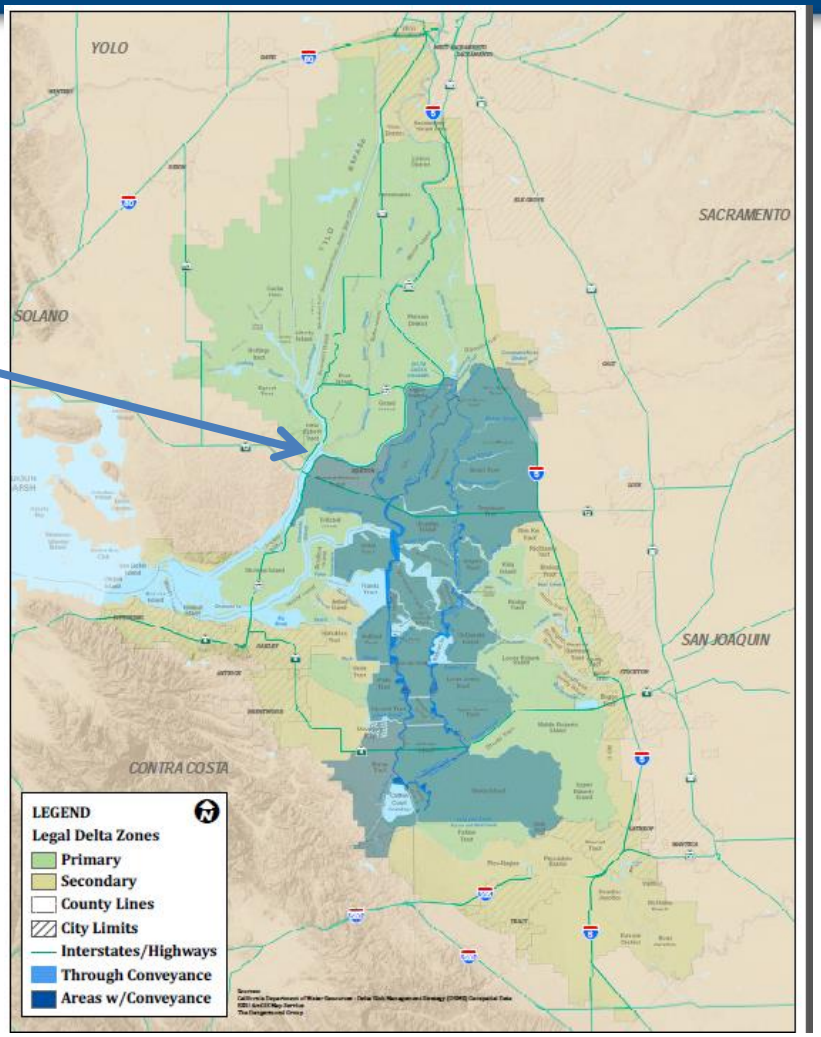
Conditional probability that breach causes a disruption to water supply (affects reliability)

Flooded Volume
- Accommodation Space
- Calculated for MHHW

Influence Factors
- Proximity of the island/tract to the through-conveyance corridor
- Modeled salinity effects associated with island flooding
- Islands containing or supporting critical in-Delta water supply infrastructure

EAW Influence Factors – Through Conveyance Corridor

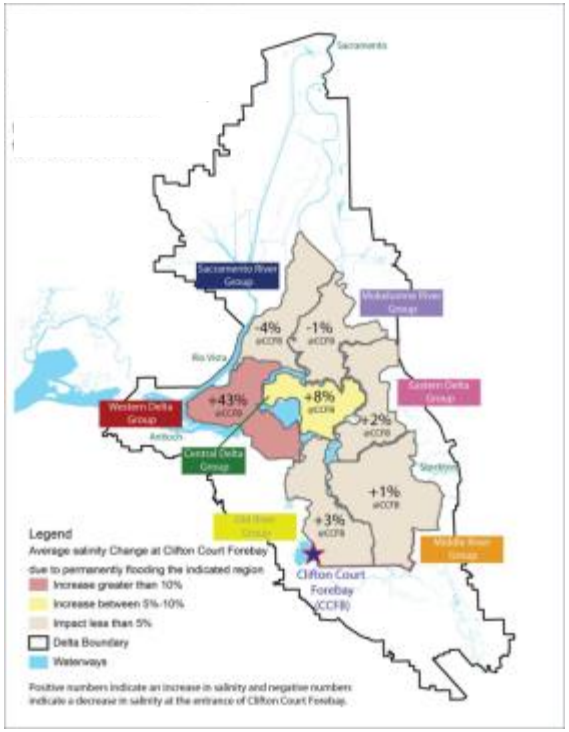
Through Conveyance



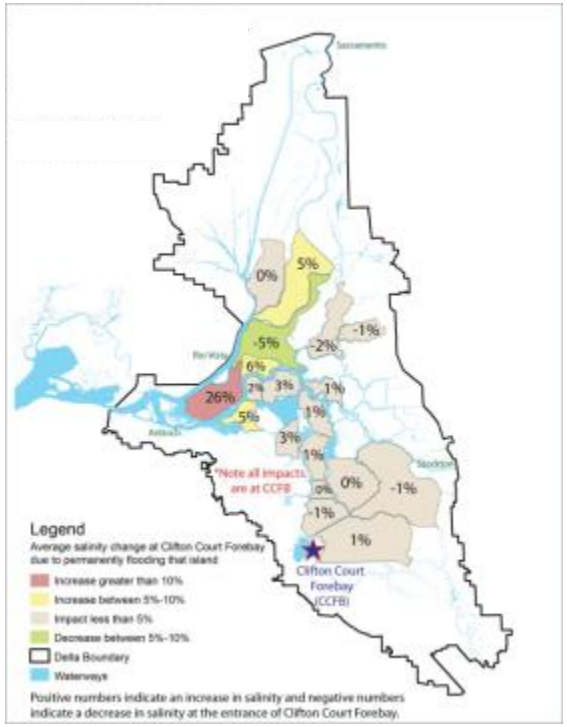
Economic Sustainability Plan

EAW Influence Factors – Salinity Intrusion

- DWR Modeling Report Results



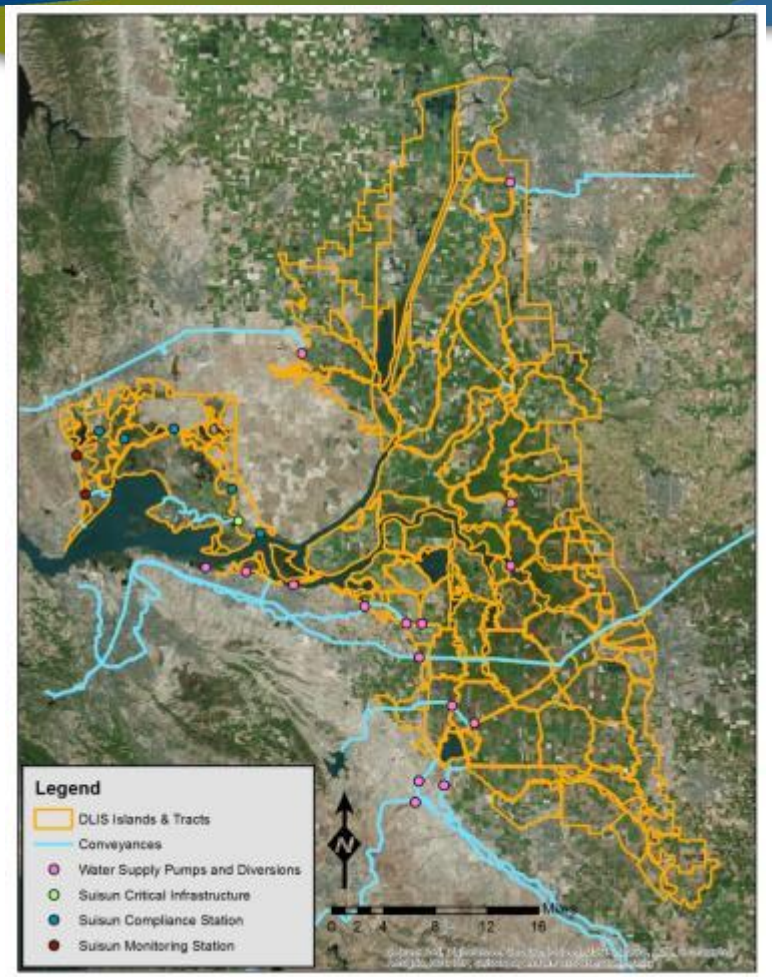
Island Group Results



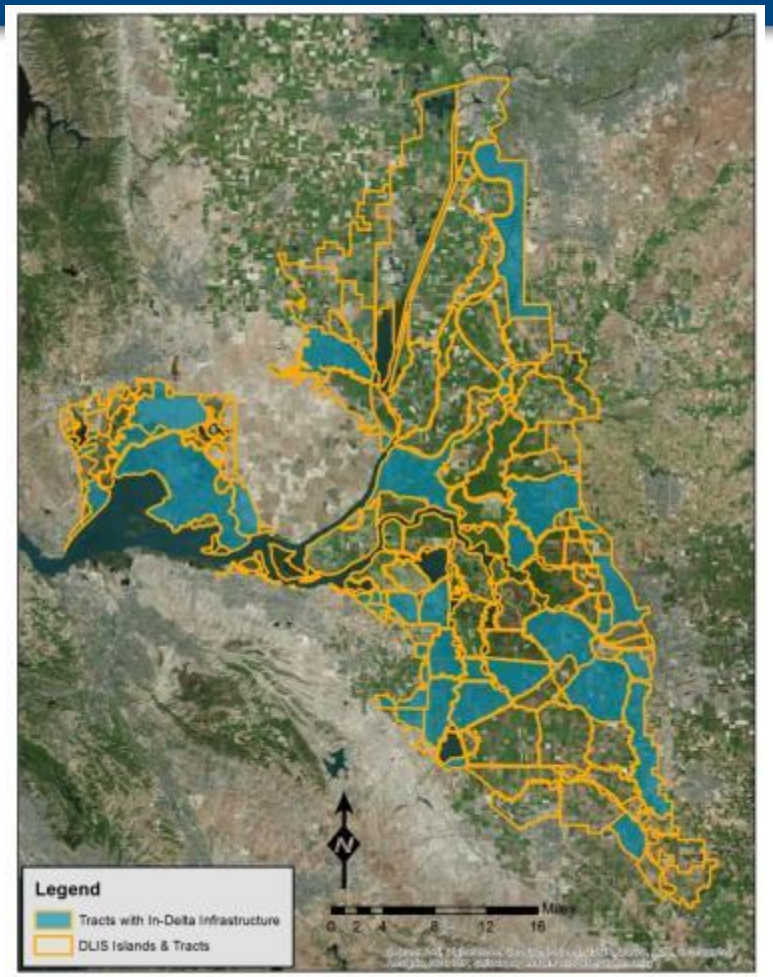
Individual Island Results

DWR, 2012 (Draft)

EAW Influence Factors – In-Delta water infrastructure

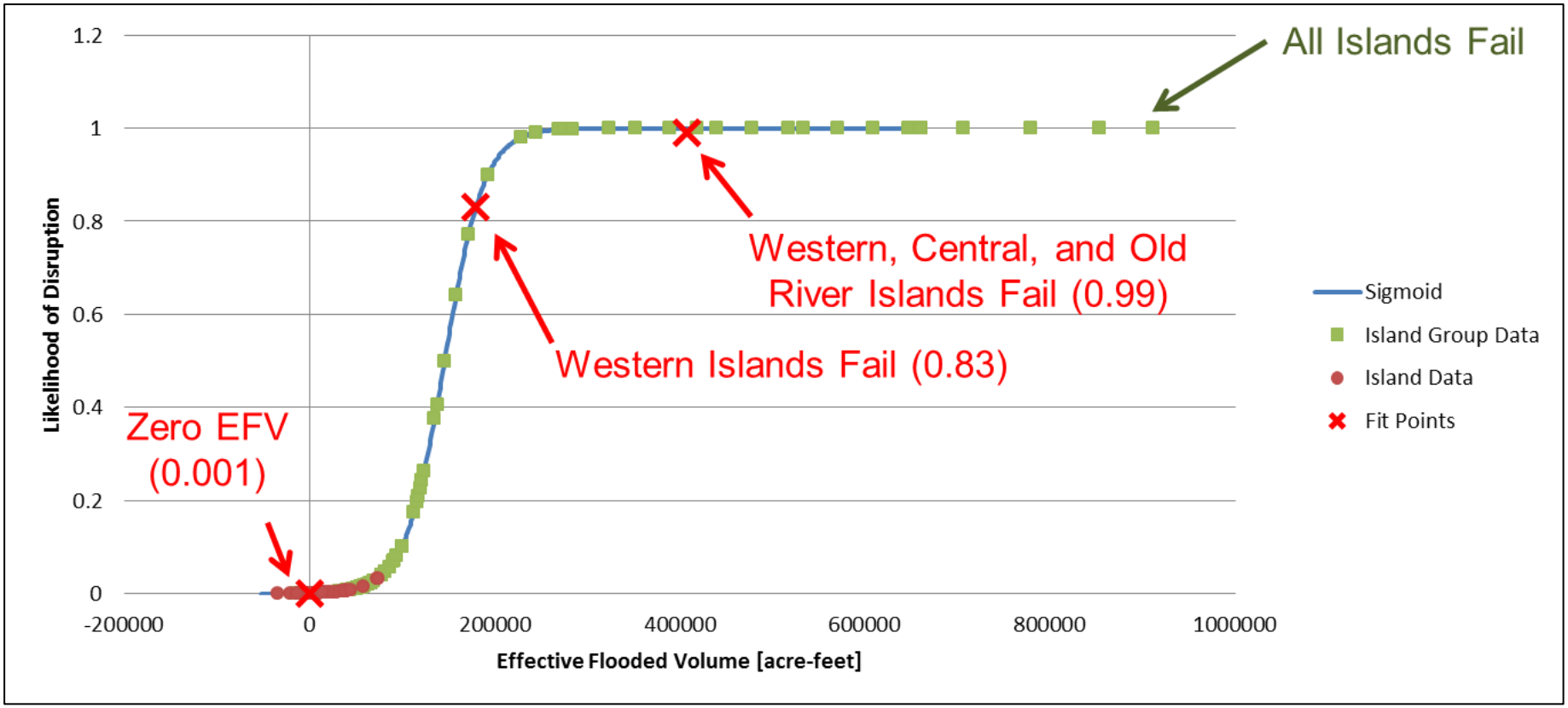


In-Delta water infrastructure



Islands/Tracts with In-Delta water infrastructure

Conceptual Model – Expected Annual Water Supply Disruption Score



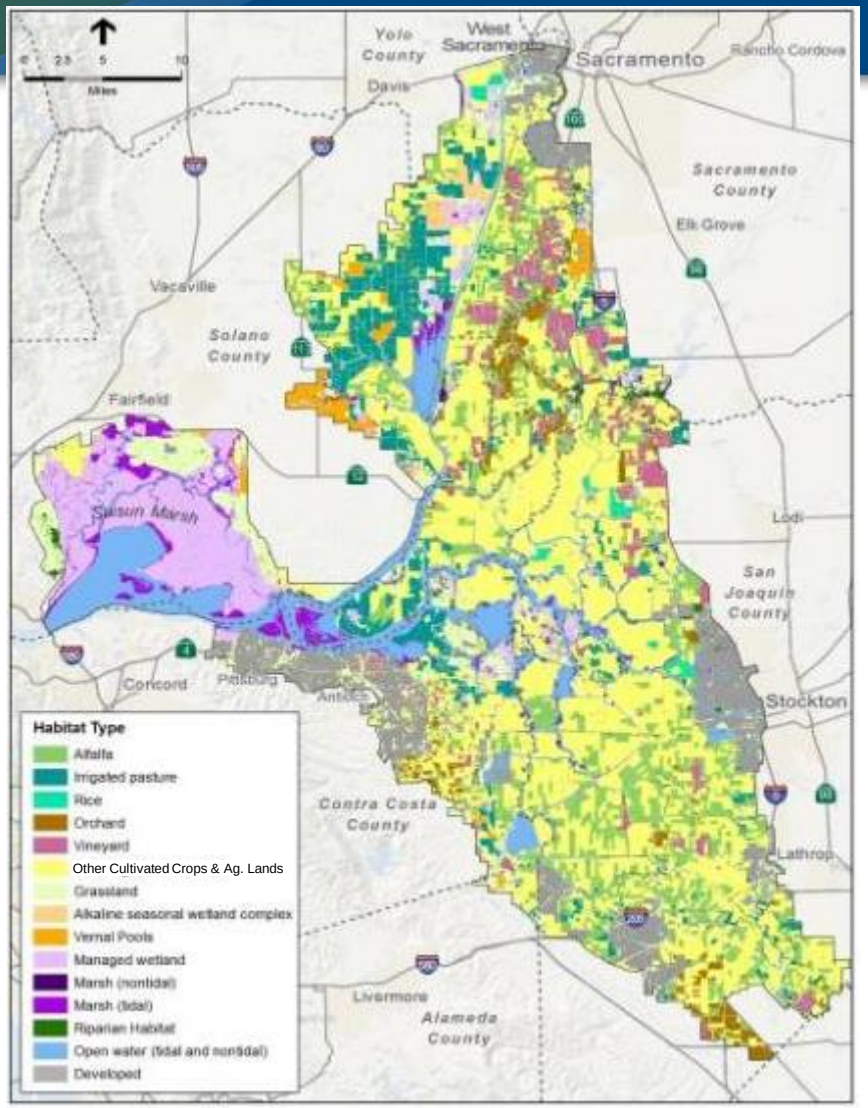
Expected Annual Change in Habitat (EACH) Conceptual Risk Model

$EACH_{(i,t)}$ *(acres by habitat type /year)* = $\sum_i$ **Probability of levee breach(i)** **x** Net change in habitat due to flooding *(by habitat type)*

Habitat Change Conceptual Model Guidance

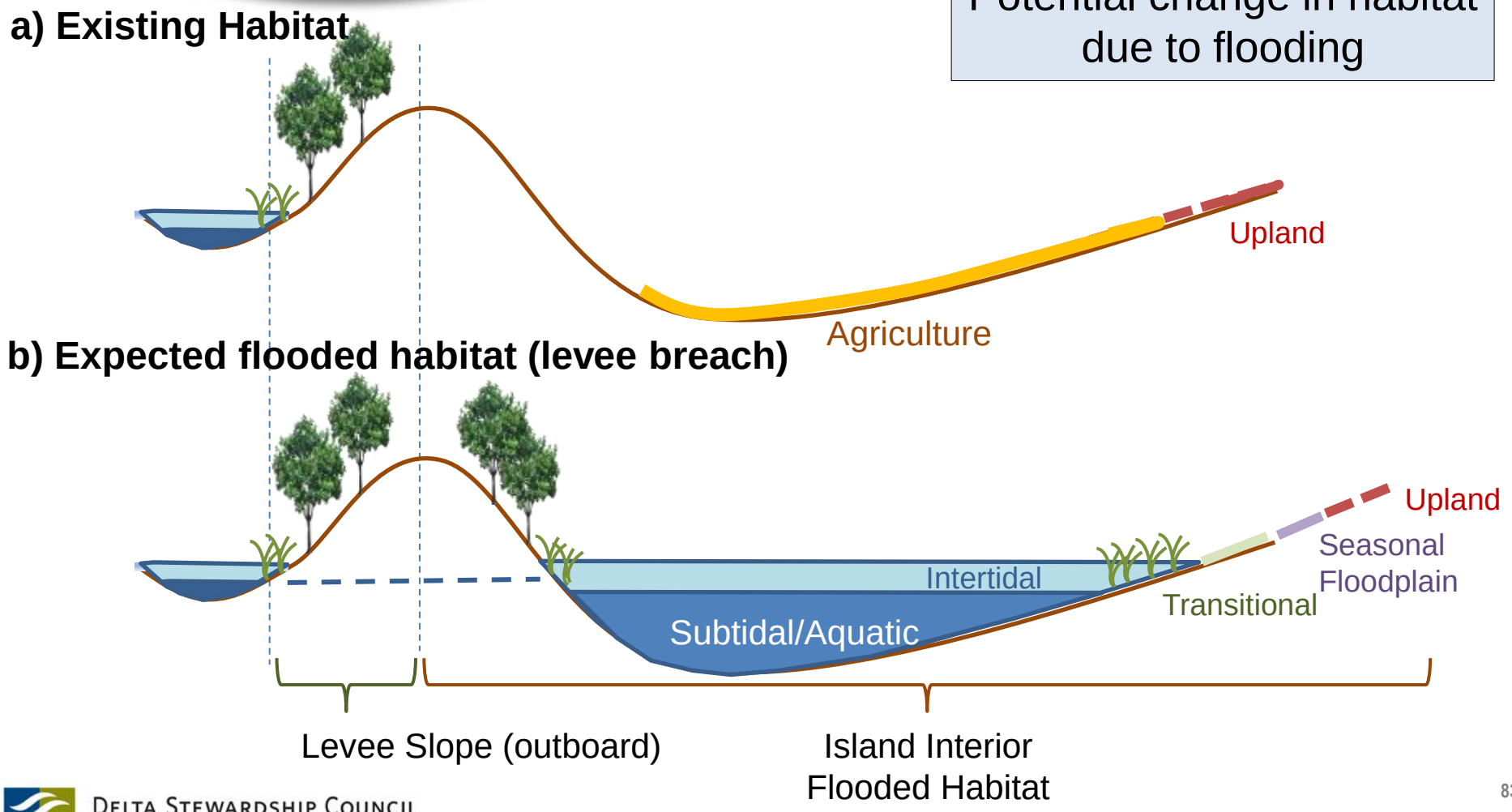
Existing habitat area	
Habitat Categories	**Habitat Quality**
Grassland	Moderate
Managed wetland	High
Marsh (non-tidal)	High
Marsh (tidal)	Very High
Open water	Varies
Riparian	Very High
Agriculture - Annual	Low to Moderate
Agriculture - Perennial	None
Developed	None

Developed for Delta Plan EIR from CDFW vegetation data and DWR crop type data



Habitat Change Conceptual Model

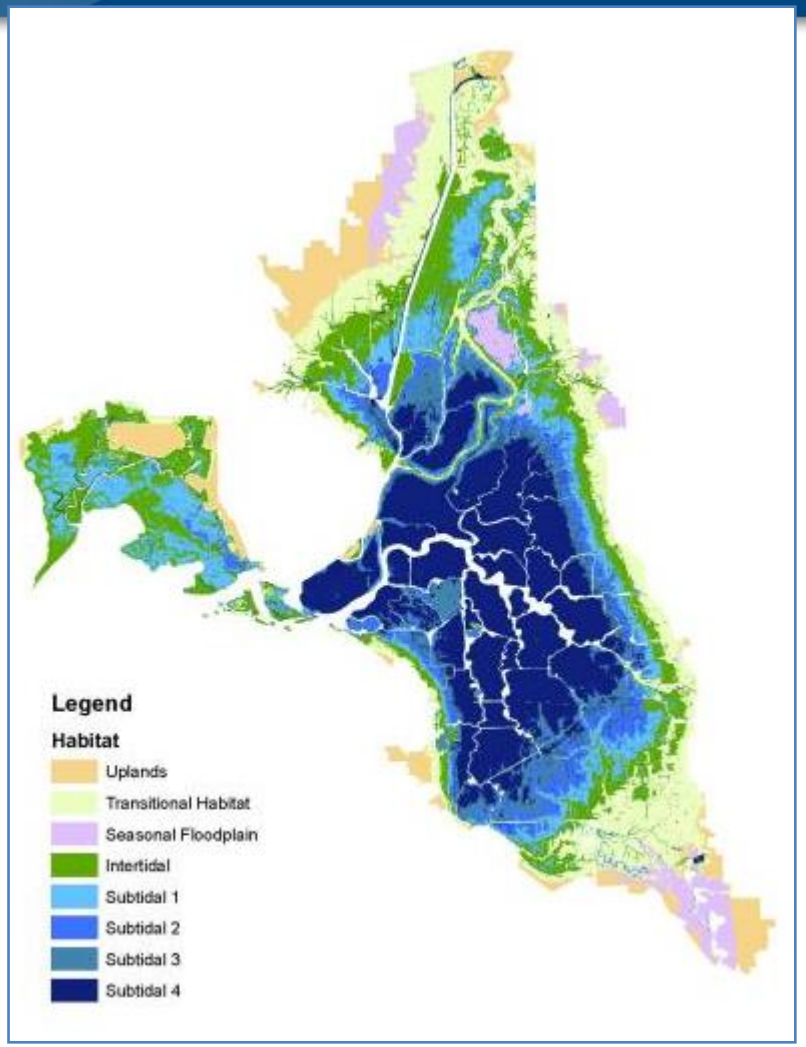
Potential change in habitat due to flooding



Habitat Change Conceptual Model

Potential change in habitat due to flooding

Flooded Island Habitat Type	Habitat Quality Value
Uplands	Moderate
Seasonal Floodplain	Very High
Transitional habitat	High
Intertidal	Very High
Subtidal	Varies



Expected Habitat Based on Elevation

2012 elevations and water levels

Investment efficiency: effects of projects on habitat

Habitat area change for each project in a portfolio

Projected Habitat Area
(By type in acres)

= +/-

Sum of habitat area change (by type) due to projects

Reported for different levels of habitat quality value

Projected Change in Natural Channel Margin
(in feet/miles)

= +/-

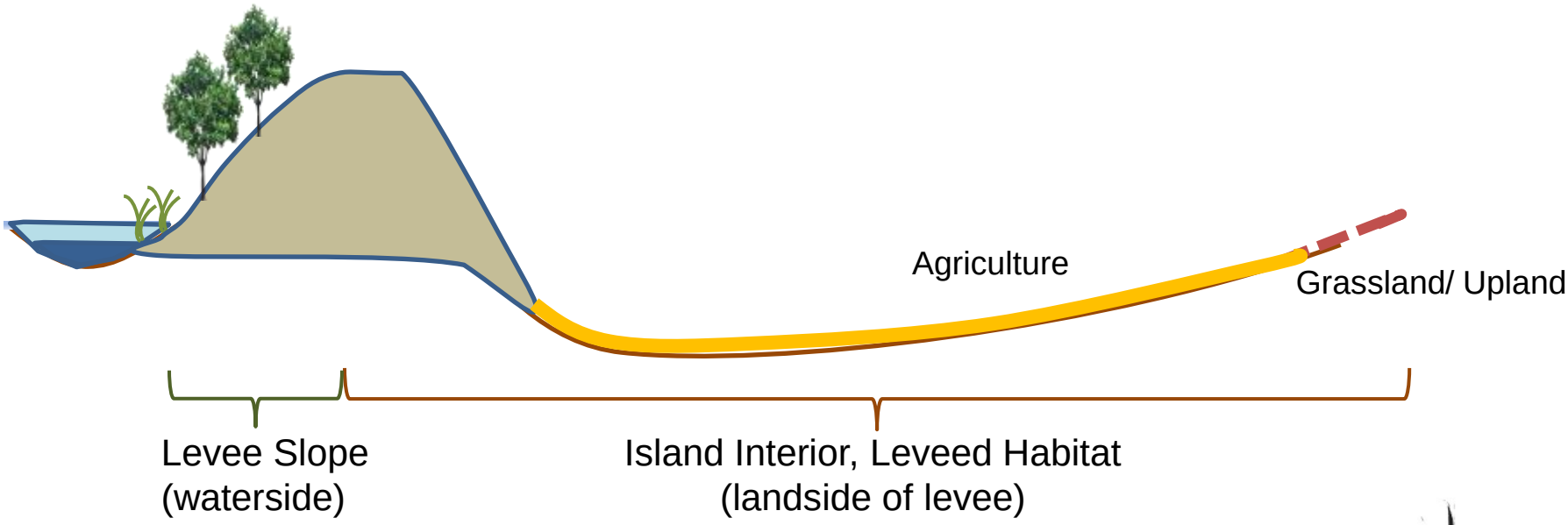
Sum of channel margin habitat change on outboard levee due to projects

Reported for proximity to fish migratory corridors (near, far)

Habitat Change Conceptual Model Guidance

Existing habitat area

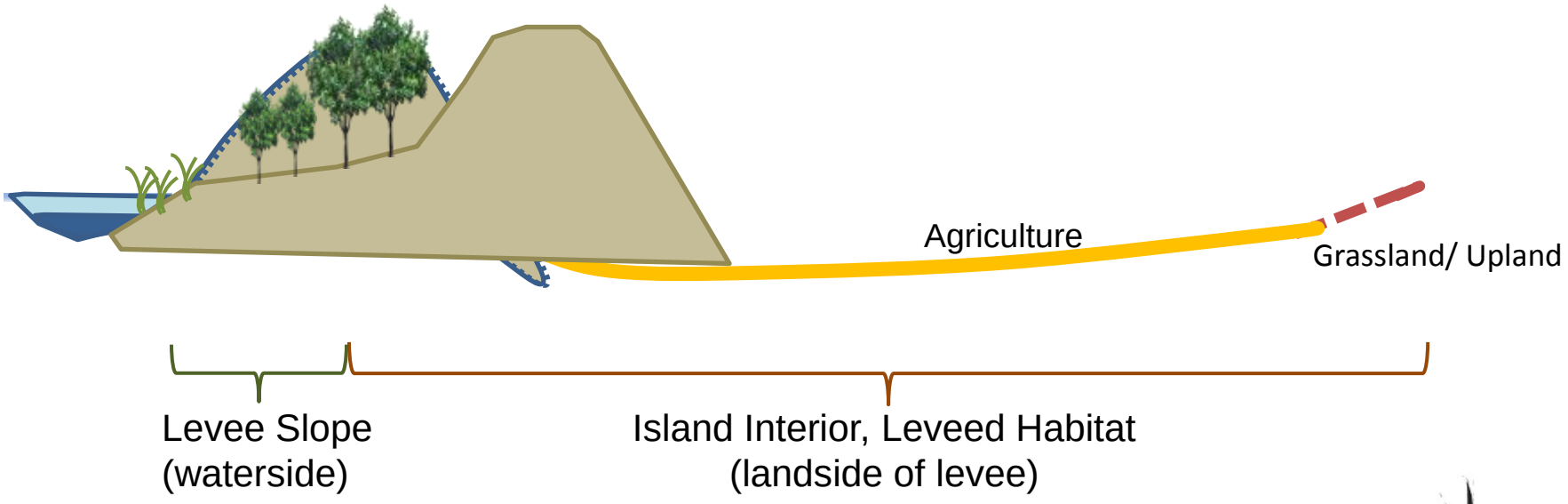
+/- Direct Project Change



Habitat Change Conceptual Model Guidance

Existing habitat area

+/- Direct Project Change



Investment efficiency: effects of projects on agricultural land area

Change in agricultural land (acres) = Sum of agricultural land lost due to projects (acres)

Expected Annual Agricultural Land Loss Conceptual Model

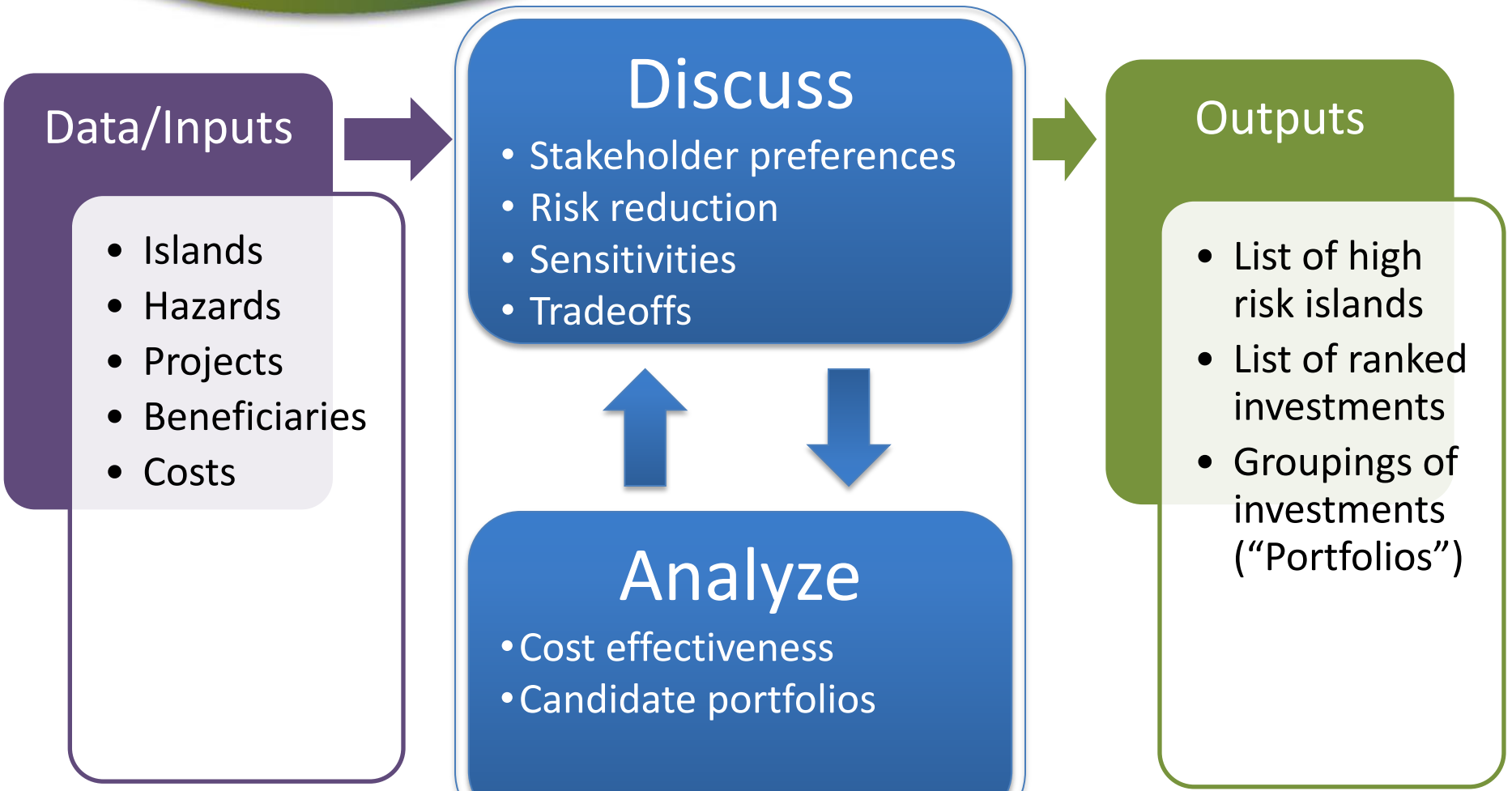
EAALL (Acres/year) = Probability of levee breach x Agricultural land lost due to flooding (acres)

*Assumes island is not rehabilitated

David Groves

BRINGING IT ALL TOGETHER

We are developing a process for credible, transparent, collaborative decision making



Islands ranked by different types of risk

- Different objectives suggest different islands at risk
- Council/stakeholder preferences incorporated to aggregate risks
- Investments evaluated focus on high-risk islands

Outputs

- **List of high risk islands**
- List of ranked investments
- Groupings of investments (“Portfolios”)

Investments ranked by ability to reduce risks

- Change in risks due to investments combined with costs
- Highly cost-effective investments are candidates for Levee Investment Strategy

Outputs

- List of high risk islands
- **List of ranked investments**
- Groupings of investments ("Portfolios")

Portfolios of investments balance risk reduction across objectives and meet key constraints

- Council and stakeholders specify preferences over risks
- Implementation constraints and assumptions about future defined (e.g. funding)
- Optimal portfolios of investments maximize risk reduction
- Portfolios are a candidate for the Delta Levee Investment Strategy

Outputs

- List of high risk islands
- List of ranked investments
- **Groupings of investments ("Portfolios")**

The Planning Tool supports this process with interactive visualizations and calculations

Data/Inputs

- Islands
- Hazards
- Projects
- Beneficiaries
- Costs

Discuss

Interactive Visualizations

Analyze

Calculations

Outputs

- List of high risk islands
- List of ranked investments
- Groupings of Investments (“Portfolios”)

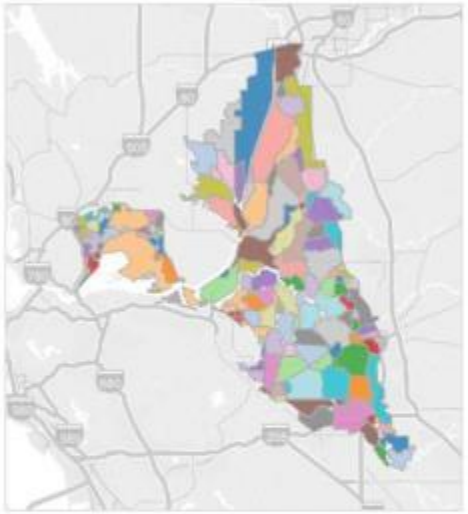
Planning Tool will synthesize key results for each stage of analysis

DLIS Planning Tool v1.1 -- PRE-REVIEW DRAFT

DLIS Planning Tool -- Version 1.1	Introduction	DLIS Analytic Steps	(1) INVENTORY ASSETS AND IDENTIFY HAZARDS	Islands and Tracts	Island Attributes	Island Habitat

Planning Tool for
Delta Levee Investment Strategy

--Version 1.1--

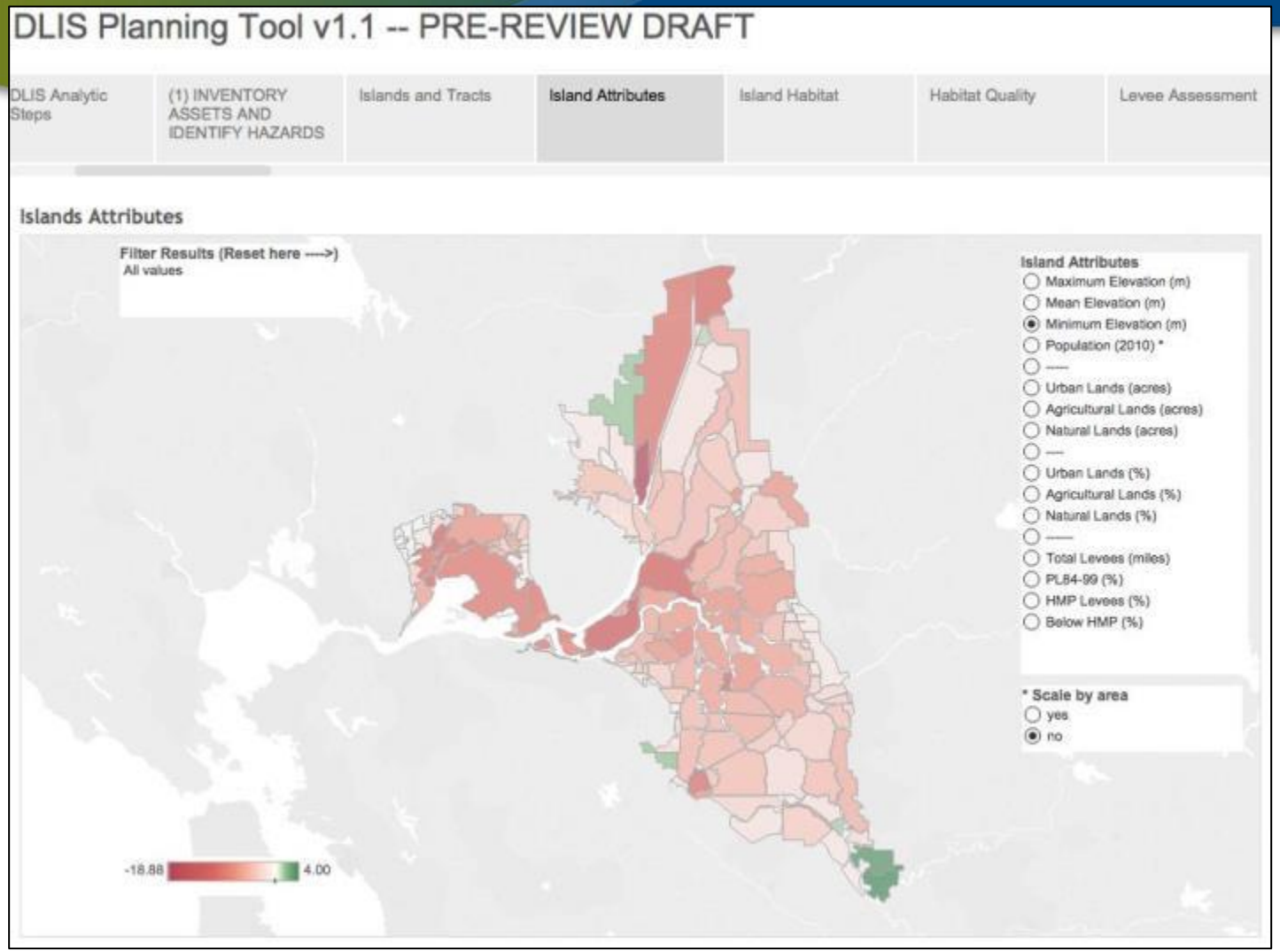


DELTA STEWARDSHIP COUNCIL

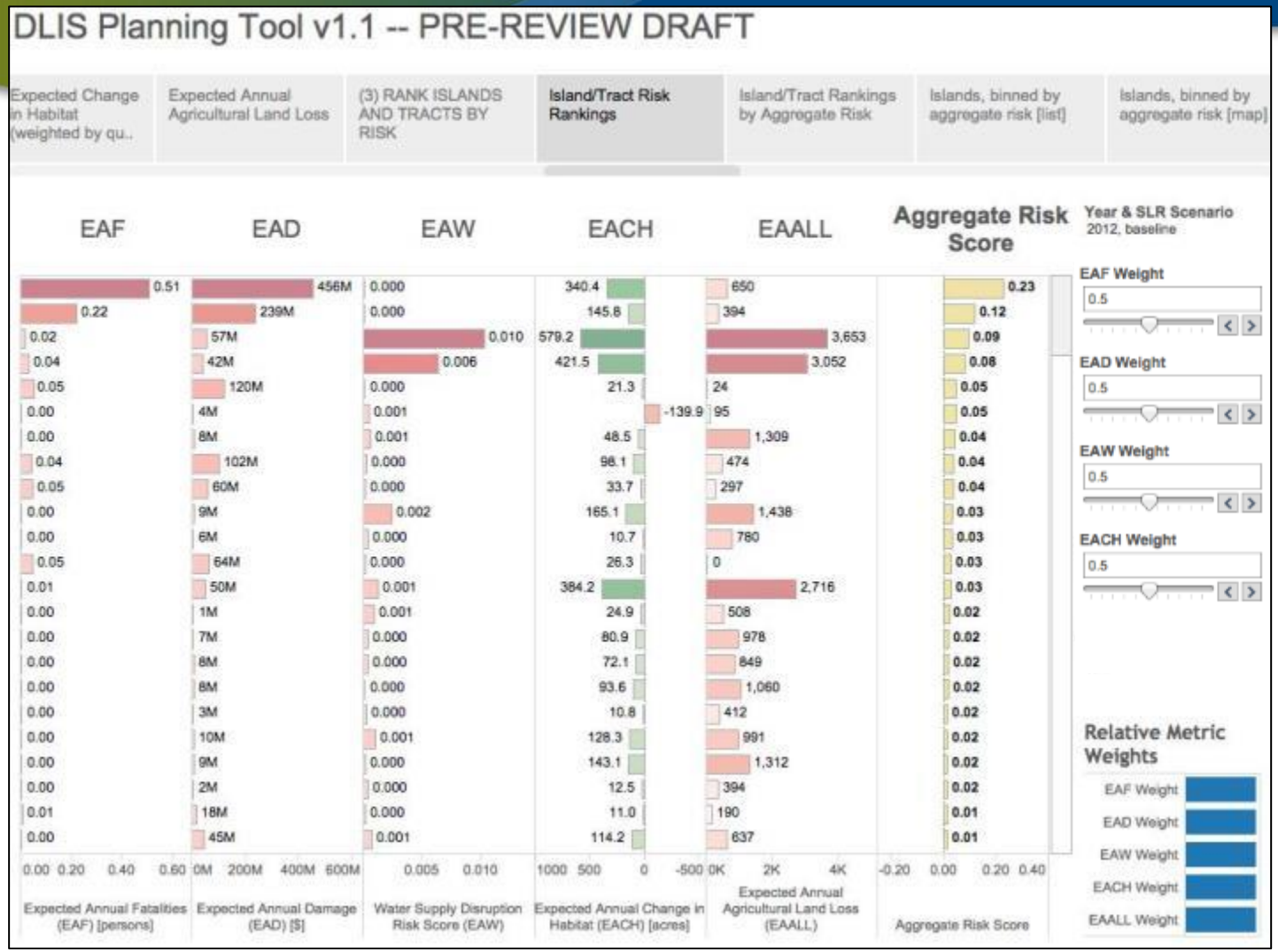
DRAFT -- Not for distribution

May 2015

Planning Tool helps visualize Delta information and analysis



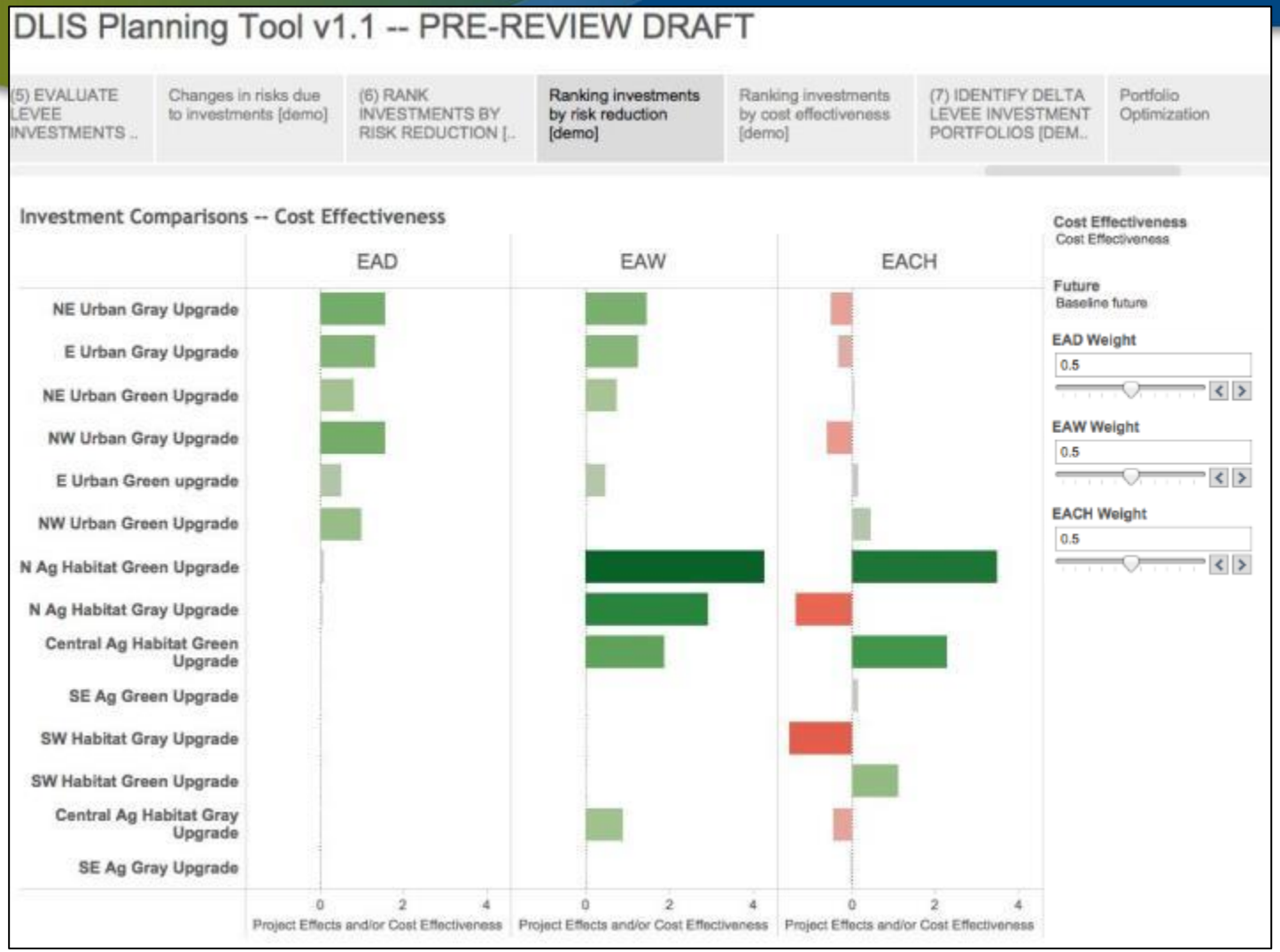
Planning Tool supports interactive ranking of islands by risk



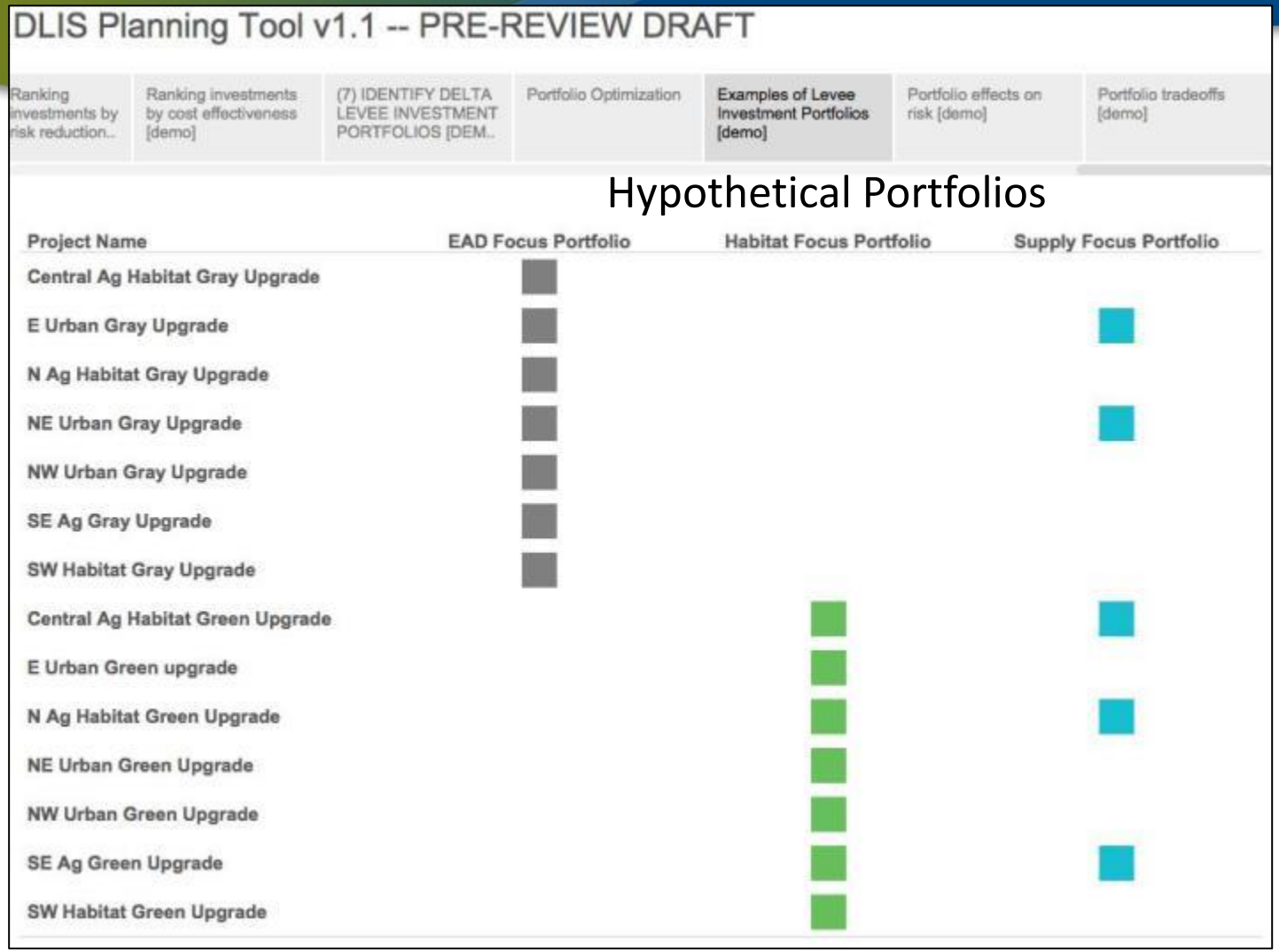
Islands / Tracts

Planning Tool supports interactive ranking of investments

Hypothetical Investments



Planning Tool develops portfolios to maximize risk reduction



Planning Tool develops portfolios and show key tradeoffs

Hypothetical Portfolios

George McMahon

COST ALLOCATION METHODOLOGY

Project purposes (cost allocation categories)

- Flood risk reduction

- Water supply reliability

- Ecosystem protection, restoration and enhancement

How should we allocate costs?

- How is **federal interest** measured?
- What informs **federal-State** cost sharing?
- How much of State share should be allocated to local management agencies (LMAs)?
- How should local shares be allocated to end users (beneficiaries)?

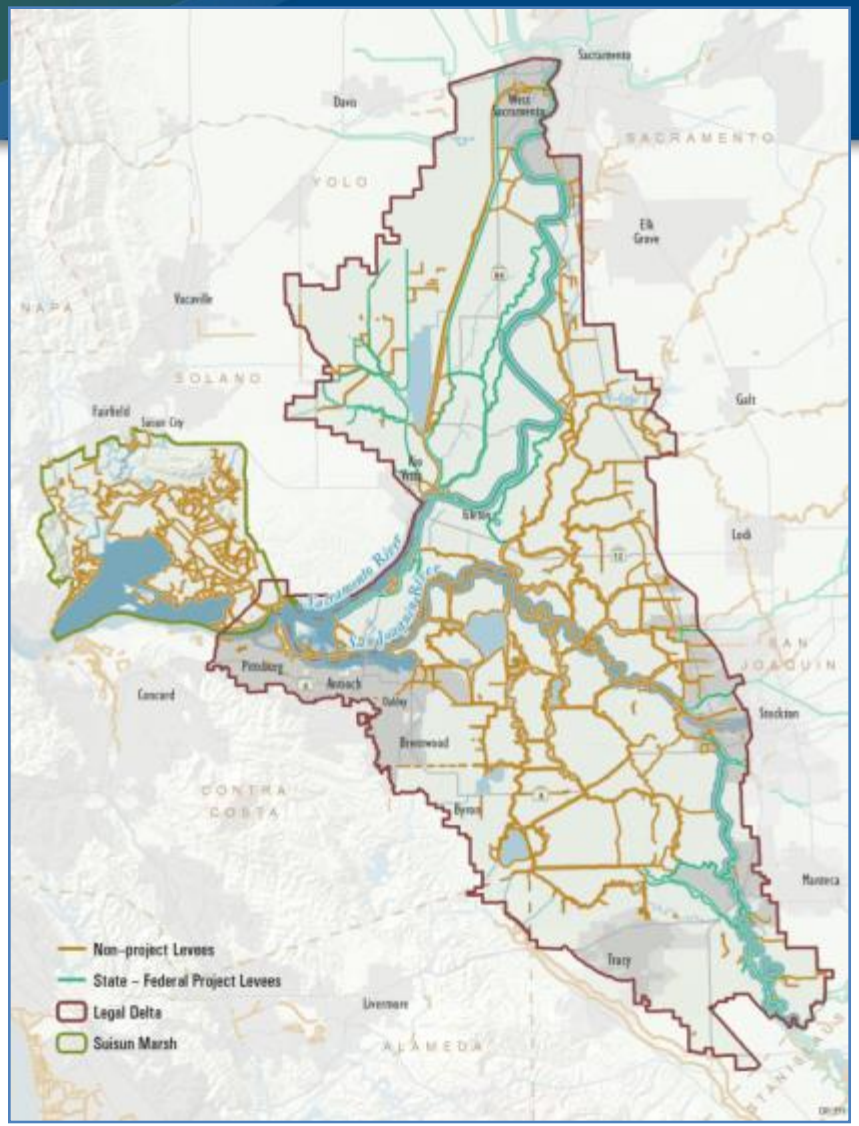
How should we allocate costs?

- Costs:
  - *Capital improvements*
  - *Operations, maintenance, repair, rehabilitation and replacement (OMRR&R)*

- Cost sharing/allocation:
  - ↓ *Federal ↔ State*
  - ↓ *State ↔ local management agencies (LMAs)*
  - *LMAs ↔ beneficiaries*

Project levees

- Project levees
  - *1/3 of Delta levees*
  - *Included in State Plan of Flood Control*
  - Capital costs shared by:
    - *Federal government*
    - *State government*
    - *Local agencies*
  - *Maintenance costs shared by:*
    - *State government*
    - *Local agencies*



Project levees – historical cost allocation practice

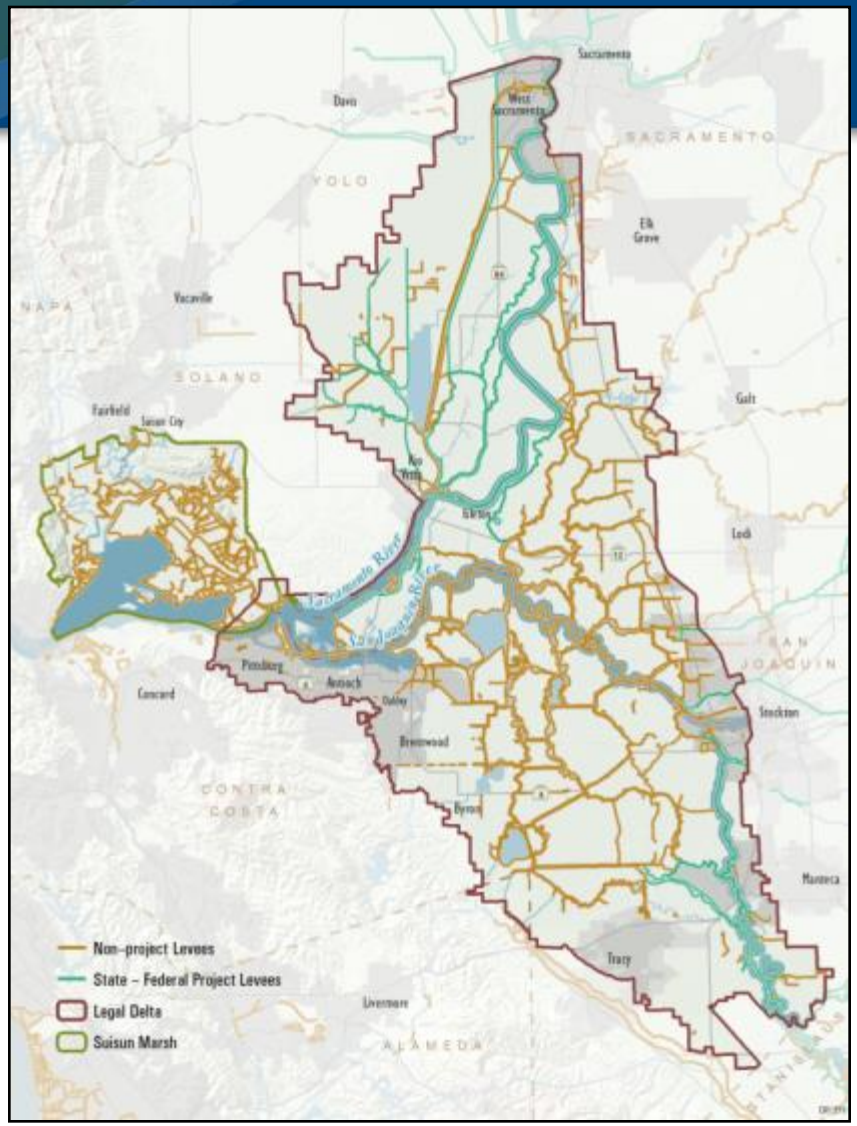
- Construction and major rehabilitation
  - *Federal share has varied between 50-75%*
  - *Non-federal share typically 70% State, 30% local*
- Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R)
  - *Local agency responsibility outside the Delta*
  - *Supported by Subventions within the Delta*

Project levees – current cost allocation policy

- Federal share can be as much as 65% for ecosystem restoration in urban areas
- Minimum State share of the non-federal portion is 50%
- State share may be increased up to 90% if the project:
  - *Serves a disadvantaged community*
  - *Improves the overall system*
  - *Includes ecosystem enhancement*
  - *Includes other multi-benefit features*
- State will share up to 80% for setback levees

Non-project levees

- Non-project levees
  - *2/3 of Delta levees*
  - *Not included in State Plan of Flood Control*
  - *DWR assistance to local agencies*
    - *Base-level share 50% - 90% based on multipurpose benefits*
    - *Up to 75% maintenance cost-sharing*



Non-project levees – current cost allocation policy

- Federal share = $0
- Non-federal (State) share up to $10 million or 100%
- State may pay up to 20% of pre-construction costs
- Base State share in Delta primary zone is 75%
- Base State share in Delta secondary zone is 50% – may be increased up to 75% based on LMAs' ability-to-pay
- Base State share may be increased by (95% maximum total):
  - *Habitat, up to 40%*
  - *Contribution to public purposes, up to 20%*
  - *Subsidence control, up to 10%*
  - *50% match for third-party contributions*

Non-project levees - current OMRR&R cost allocation policy

- Subventions policy – Water Code section 12986
  - *Subject to availability of State funds*
  - *Up to 75% after local agencies have expended $1,000 per mile*
- The Water Code requires:
  - *Local agency provide information on ability-to-pay*
  - *DWR use ability-to-pay as basis for determining reimbursement*
  - *Requirement for ability-to-pay information expires July 1, 2018*
  - *After July 1, 2018, up to 75% after local agencies have expended $1,000 per mile*

First step in cost allocation methodology should guide:

- **Project levees:** Determination of federal interest and federal–State sharing of total project costs

- **Non-project levees:** Determination of State interest and State–LMA sharing of non-federal costs
  - *Capital costs*
  - *OMRR&R costs*

CA DWR economic analysis policy[1]

Because of its considerable water management partnerships with the Federal government, the Department of Water Resources (DWR) has a policy that all economic analyses conducted for its internal use on programs and projects be fundamentally consistent with the Federal Economics and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G), which was adopted by the US Water Resources Council on March 10, 1983. The P&G set forth principles "...intended to ensure proper and consistent planning by Federal agencies in the formulation and evaluation of water and related land resources implementation studies..." and guidelines that "...establish standards and procedures for use by Federal agencies in formulating and evaluating alternative plans for water and related land resources implementation studies."

[1]CA DWR (January 2008). *Economic Analysis Guidebook*

CA DWR recommended cost allocation procedure: Separable Costs-Remaining Benefits (SCRB)

The SCRB method includes the following steps:

1) The benefits for each purpose are estimated.
2) The alternative costs of single-purpose projects to obtain the same benefits are estimated.
3) The lesser of the two items above is selected for each purpose as the maximum amount which can be allocated to the purpose and is designated as the justifiable cost.
4) The separable cost of each purpose is estimated. The project with the purpose omitted should be the least costly project capable of providing the same benefits for the remaining project purposes. That project can be at the same site, but can also be at another site as long as the service areas for the remaining purposes are the same.
5) The separable cost of each purpose is deducted from the justifiable costs to determine its remaining justifiable costs.
6) The percentage distribution of the remaining justifiable costs is determined.
7) The total separable cost is deducted from total project cost to determine the total remaining joint costs which are distributed proportionately by applying the percentages found in step 6.
8) The cost allocation to each purpose is the sum of the distributed remaining joint cost and the separable cost.

Proper application of SCRB ensures:

- **Fairness:**
  - *All purposes share equitably in the benefits of multipurpose development*
  - *No purpose subsidizes any other*

- **Efficiency:**
  - *Cost of participation < cost of single-purpose alternative*

Example SCRB application – Hamilton City flood protection project

Table B-10 Preliminary cost allocation using SCRB Method (October 2003 price levels)

			Annual costs (in $1,000)
Total project annual first cost (a+b+c)			2,687
(a) Flood damage reduction (FDR) separable costs			67
(b) Ecosystem restoration (ER) separable costs			1,797
(c) Joint costs			823
	Annual costs and benefits (in $1,000)		
	FDR	ER	Total
(d) Average annual benefits	577	888 AAHUs	
(e) Least cost single purpose alternative plan	922 (Alt 1)	3,521 (Alt 3)	
(f) Limited benefits (lesser of d and e)	577	3,521	
(g) Separable costs (a and b)	67	1,797	
(h) Remaining benefits (f - g)	510	1,724	2,234
(i) Percentage of remaining benefits	23%	77%	
(j) Allocated joint costs (c x h)	189	634	823
(k) Total allocated costs (I + a and i+b)	256	2,431	2,687

State – LMA cost sharing based on ability-to-pay (ATP)

- Benefits-based approach
  - *Uses EAD averted to determine economic benefits of the project*
- Financial-based approach
  - *Uses projected revenues, expenses, assets, and debts of the local agency*
  - *Economic benefits are not directly considered*

LMA – user cost sharing and distribution of user costs

- Facilitated negotiation approach
- Non-facilitated (market-based) approach
- User fees

Summary of cost allocation methodology

- **Objectives:**
  - Fair allocation of project costs in proportion to benefits received
  - No cross-subsidization between purposes

- **Step 1:** Cost allocation by purpose (benefit category) using SCRB
- **Step 2:** Determination of State interest and share (remaining after federal share) by purpose, for project and non-project levees
- **Step 3:** Determination of local share (remaining after State share) by purpose based on ability to pay (ATP)
- **Step 4:** Final allocation of user costs (remaining after local share) to beneficiaries

Delta Levees Investment Strategy

CONCLUSION AND WHAT'S NEXT?

Summary to date

- We have established a rational basis for assessing relative risks in the Delta
- The assessment of relative risk can be readily updated based on new or changing information
- Proposed levee improvement projects can be readily measured and compared for their
  - *Ability to reduce risk to lives and property, to water supply, to the ecosystem, and to Delta as a place*
  - *Cost-effectiveness*
- We have assessed current cost allocation methods

Summary to date

- We have established a rational basis for assessing relative risks in the Delta
- The assessment of relative risk can be readily updated based on new or changing information
- Proposed levee improvement projects can be readily measured and compared for their
  - *Ability to reduce risk to lives and property, to water supply, to the ecosystem, and to Delta as a place*
  - *Cost-effectiveness*
- We have assessed current cost allocation methods

Next steps

- Adjust methodology as recommended by peer review
- Identify conceptual projects for analysis
  - *Select areas based on risk*
  - *Analyze achieving PL 84-99 throughout the Delta for comparison*
- Identify portfolios using methodology
- Recommend a cost allocation method
- Prepare a Delta levees investment strategy
- Analyze the impacts (CEQA) from new policies and regulations in the Delta Plan resulting from implementation of the Delta levees investment strategy

WHO WANTS ICE CREAM?

(RANDY'S BUYING)